

**PUBLIC SPACE DESIGN PRINCIPLES FOR
HOT SEMI-ARID CLIMATES**
A Case of the Urban Park at Isiolo Municipality

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DECLARATION

I declare that this research project is original work and affirm, to the best of my knowledge that this research project has not been presented at any university for examination or any other purpose.



Signed: Salaash Katumpe (Candidate)



Date

The submission of this research project to the university has supervisors' approval.



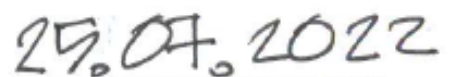
Signed: Prof. Anyamba, T.J.C (Supervisor)



Date



Signed: Arch. Abonyo, E.O (Supervisor)



Date

DEDICATION

The research project's dedication is to Fidelis Nabiki, Ann Kanja, Natania Nabiki, Malkiel Meikan, Katumpe's family, and friends.

ACKNOWLEDGMENT

I acknowledge the assistance of various people, without whom this research project would not have been possible. I extend my heartfelt gratitude to my supervisors, Prof. Anyamba and Arch. Abonyo for their unlimited guidance and support. I am greatly indebted to the master of architecture 2016/2018 tutors for their invaluable advice, assistance, and eye-opening insights. Finally, I extend my special gratitude to the chairman and the architecture department's staff for their support.

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ABBREVIATIONS AND ACRONYMS

APA- America Planning Association

CDP- County development profile

CIDP- County integrated development plan

EPA- Environmental Protection Agency; United States

GOK- Government of Kenya

HDI-Human development indicators

KNBS- Kenya National Bureau of Statistics

KNHDR-Kenya National Human Development Report

KNSP- Kenya National Spatial Plan

KNUDP- Kenya National Urban Development Policy

KUSP-Kenya Urban Support Program

LAPSSET-Lamu Port South Sudan Ethiopia Transport

SEA- Strategic Environmental Assessment

SDG- Sustainable Development Goals

ULI- Urban Land Institute

UNDP-United Nations Development Program

UNEP –United Nations Environment Program

UNESCO- United Nations Educational, Scientific and Cultural Organization

UNHSP –United Nations Human Settlement Program

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ABSTRACT

Public spaces define the character of a city and are critical in determining the quality of life in urban areas; however, they face neglect. The situation is worse in hot semi-arid due to climatic restrictions. This study is on their organization at a macro level, their use, their response to climate, and their sustainability at a micro-level in Isiolo municipality, which experiences high temperatures and strong winds.

The study reviews public space as an element of urban design. It views the intelligent urbanism theory, spatial index concept, and Dodoma's open space system as crucial concepts in understanding public spaces in the hot semi-arid. The study reviews the space-shaping continuum theory and the placemaking concept to highlight the usefulness of public spaces. The study reviews climatic parameters in public space design and sustainable design concepts in hot semi-arid climates.

The study uses the Isiolo municipality's development plan as a base map in preparing a GIS-based land-use plan, a public open space plan, and maps out the Urban Park. The study derives units of analysis from reviewed theories and concepts. Data is collected using questionnaires, observation checklists, photos, and focused group discussions and analyzed using tables and charts.

The study finds that public spaces at Isiolo account for 6% against recommended 13% of the land use translating to 19.6m² per person against 62m² per person; they are uneven in distribution and are of low quality due to maintenance budget of 0.14ksh per m² per annum. The study finds design measures for enhancing use on a scale of 1-5 as inadequate and rates them 2. The study finds design interventions in response to climate as highly inefficient on a scale of 1-5 and places them at 1. The sustainable design concepts presented are found to be appropriate and rated (4) on a scale of 1-5.

The study recommends the use of public open spaces as the main organizing element in hot and semi-arid climates. The study recommends introducing activities like cultural play areas and children's play areas to enhance the use and use of water features to draw in users. The study suggests using windbreakers on the southern side, water features, lawns, and shades to enhance comfort. The study also recommends using local and new technologies to improve sustainability; like water harvesting; using water ponds, and solar energy to light the urban park. The study proposes the spatial index principle, the utility principle, the climate-responsive principle, and the sustainable design principle as the guiding principles for public spaces in hot semi-arid climates.

CHAPTER I –INTRODUCTION

Chapter one covers; the problem background and statement, objectives, research questions, significance and justification of the study, the scope, limitations, and overall structure of the study.

1.0 Background of the study

Great public spaces are the living room of a city- where people come to enjoy urban life. Public spaces make high quality of life, and they range from grand central plazas and squares to small neighborhood parks. However, their great value is often overlooked or underestimated by policymakers, leaders, and developers. Therefore, urban designers have to advocate for great public spaces and design them as; vibrant, sustainable, and aesthetically appealing.

Climatic conditions can limit the use of public spaces and their sustainability. Therefore, urban designers must arm themselves with climatic knowledge and develop climate-responsive designs that integrate scientific information on climate with creative design.

According to Koppen's climate classification, the hot semi-arid is a dry tropical climate. This climatic zone covers the most expansive area of Eastern Africa (UN-Habitat, 2014). Kenya's six climatic divisions concerning design are; coast, semi-desert, hot semi-arid (Savannah), lake, highland, and upper highland zone (Hooper, 1975).

Hooper (1975) and UN-Habitat (2014) identify Isiolo municipality as a leading urban center in the hot semi-arid. Isiolo municipality is located strategically at the geographic center of Kenya; an attribute shared with Dodoma Tanzania-another hot semi-arid city. Kenya's vision 2030 sets Isiolo municipality as a resort city in the LAPPSET corridor.

There are enormous climate-related challenges like high temperatures, high winds, aridity, and floods facing urban centers in hot semi-arid climates. These challenges call for sustainable urban design intervention, especially in designing public spaces that create micro-climates in urban environments that enhance user comfort.

1.1 Problem Statement

In hot semi-arid climates, high temperatures during the day impose severe restrictions on people's outdoor activities (UN-Habitat, 2014). This restriction diminishes the significance of public spaces in these areas, and the great value of public spaces is lost, overlooked, or underestimated. Therefore, there is a need for functional public open spaces that suit hot

semi-arid climates; however, urban designers have not yet developed the design principles necessary for great public spaces in hot semi-arid climates.

Isiolo municipality is an excellent example of an urban center in a hot semi-arid climatic zone, where climatic conditions severely restrict public open spaces. Isiolo municipality is also a strategic node, the epicenter of Kenya's vision 2030, with three major flagship projects; the Isiolo airport, the Isiolo resort city, and the Isiolo oil storage facilities.

Functional public open spaces in Isiolo municipality will enhance the envisioned resort city. Therefore, there is a need to map and document public open spaces in Isiolo municipality; and establish design principles for public open spaces in Isiolo municipality.

1.2 Objectives

- i. To map and document public open spaces in the hot semi-arid climate in the Isiolo municipality
- ii. To review the utility of the urban park in the hot semi-arid climate in the Isiolo municipality
- iii. To propose/generate public space design principles necessary for public open spaces in hot semi-arid climates

1.3 Research Questions

- i. What is the status of public open spaces in the hot semi-arid climate in the Isiolo municipality?
- ii. How is the urban park utilized in the hot semi-arid climate in the Isiolo municipality?
- iii. Which public space design principles are necessary for public open spaces in hot semi-arid climates?

1.4 Significance

The study seeks to establish the status of public open spaces in hot semi-arid climates; establish best design practices for public open spaces in hot semi-arid and provide principles that guide great public open spaces design in these climatic zones

The study will be a reference material for those studying and developing public open spaces in a given climatic area and very insightful for public open spaces design in hot semi-arid climates.

1.5 Justification

Public spaces are critical in defining the quality of life in urban areas; however, they are endangered spaces, as observed by Makworo & Mireri (2011). The situation is made worse in arid cities due to climatic restrictions and their sustainability. However, public spaces are among the many ways of achieving sustainable cities and communities (SDG-goal 11 target 7). The UN-Habitat launched a global public spaces program in 2011; developed the charter of public spaces (adopted in 2013); established a public spaces tool kit (designed in 2016); and made public spaces the main plan of the new urban agenda (2016 at Quito in Ecuador).

The National Urban Development Policy highlights public open spaces as an urban social and economic infrastructure aspect in Kenya. The policy aligns with vision 2030 and the Kenya constitution of 2010.

Through the Kenya Urban Support Program (KUSP), the Kenyan government issued grants to urban centers to develop and manage urban areas where public open spaces are key priority areas.

Public spaces are the living room of a city and provide a platform for the urban community to interact, and enhance the urban culture and expression itself. In hot climates, their uses are restricted and are primarily nocturnal. Concepts like place making are applied to improve the use of public open spaces. However, they focus more on activities therein, ignoring the impacts of climate. Climate change, global warming, urban heat island, and thermal comfort have necessitated the shift in design approach issues resulting in sustainable design: which is still unexplored in tropical climates, especially in Eastern Africa (UN-Habitat, 2014).

Urban designers can learn best practices in comparable climatic regions like hot and dry areas, semi-arid areas, places with similar challenges like flooding, and similar landscapes to develop climate-responsive designs in hot semi-arid. For example, in Isiolo municipality, public open spaces can play a crucial role in improving the microclimate and enhancing life quality.

In urban design, a study on public spaces offers a good surrogate for the urban design process as public schemes typically sit at the heart of more extensive development and policy propositions or long-term 'natural strategies of urban adaptation and change (Carmona, 2014).

Figure 1.1 shows the effect on the air temperature of the urban heat island (UN-Habitat, 2014).No table of figures entries found.

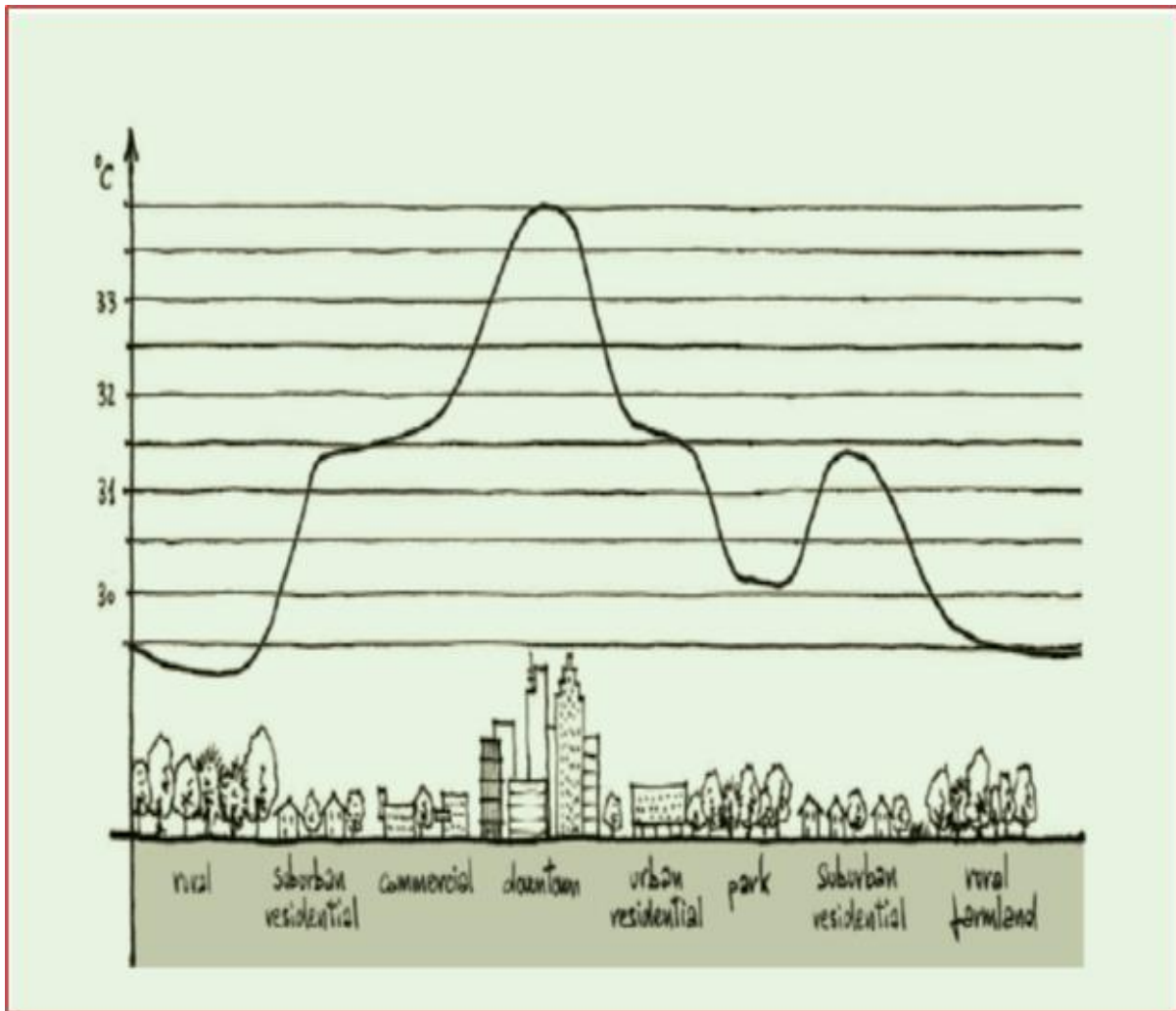


Figure 1.1: Relationship between air temperature and urban surfaces.
Source: UN-Habitat, 2014

1.6 Study Scope

The study has a theoretical and geographical scope, expounded as follows;

1.6.1 Theoretical scope

The study focuses on public spaces as an urban design element as established in the urban design theory. In addition, the study adopts the principles of intelligent urbanism theory, developed by Benninger (2001), the backbone theory of Kenya's urban development policy. In public open spaces design, the study anchors on the place making concept by UN-Habitat (2016) and space-shaping continuum theory- a theory of urban design process, developed by Carmona (2014).

The study narrows down to Isiolo's Urban Park, a great public open space that can be des

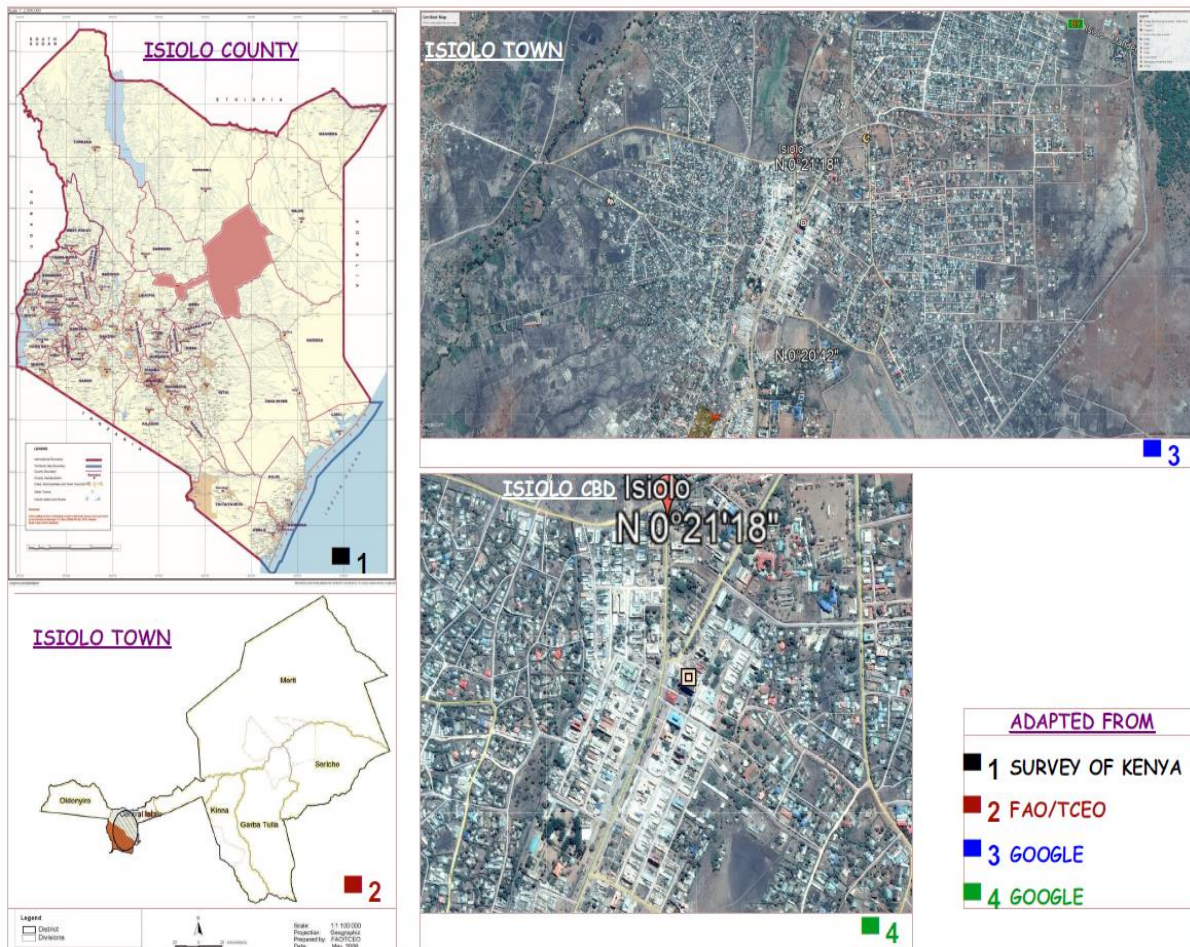


Figure 1.3: Map of Isiolo municipality
 Source: Adapted from Survey of Kenya, FAO/TCEO and Google map, 2018

1.7 Study Limitations

The study is climatically limited to hot and semi-arid climates; geographically limited to the Urban Park of Isiolo municipality and theoretically limited to public space as an urban design element. These limitations are due to the scope of the study being influenced by time and finances.

1.8 Operational definition of terms

The following are critical operational terms used;

Public spaces:

"Public spaces relate to all those parts of the built and natural environment where the public has free access. It encompasses- all the streets, squares, and other rights of way, whether predominantly in residential, commercial, or community/civic uses; the open spaces and parks, and the "public/private" spaces where public access is unrestricted (at least during daylight hours). It includes the interfaces with key internal and private spaces to which the public normally has free access." (Carmona et al. 2004:10)

Public open spaces design:

Public open spaces design is a continuous place-shaping process of molding space in an integrated framework. (Carmona et al. 2004:10)

Hot semi-arid climate:

The hot semi-arid climate is one of the climatic regions found in the tropical area (UN-Habitat, 2014). Hooper (1975) terms the hot semi-arid climate as savannah.

Principles:

A collection of comprehensive and fundamental laws, doctrines, or assumptions (Webster, 2015)

1.9 Structure of the monograph

The study is structured into five chapters as outlined below;

Chapter one of the study is an introduction that comprises the background of the study, problem statement, objectives of the study, research questions, significance, and justification of the study. It also outlines the theoretical and geographical scope of the study, limitations of the study, operational definition of terms used in the research, and structure of the study.

Chapter two reviews the status of public open spaces as observed by the global public open spaces tool kit, dimensions of public open spaces design, and environmental design considerations in public open spaces design. The chapter reviews the Principles of intelligent urbanism theory and place-shaping continuum theory, place-making concept, ecological design, and sustainable design concepts. In addition, the chapter reviews case studies and highlights lessons learned from each.

Chapter three expounds on research design, sampling design, unit of analysis, population frame; sample size and technique; data collection, analysis validation, and presentation.

Chapter four is a brief background of the study area concerning Kenya's vision for 2030. The chapter outlines research findings based on the three objectives

Chapter five describes the public space design principles developed for the Urban Park in Isiolo municipality.

CHAPTER II - REVIEW OF LITERATURE

Chapter two reviews relevant theories, and concepts and discusses selected case studies comparable with public open spaces of Isiolo municipality.

2.1 Mapping and documentation of public open spaces

Various scholars review aspects of public space design, development, and management. For example, Smith (2016) focuses on the management aspect and observes that; centrally located public open spaces in cities have always acted as venues for events, which leads to privatization, commercialization, and securitization of public open spaces.

Gehl and Gemzoe (2001) focus on use and observers; public open spaces offer three crucial functions: meeting place, marketplace, and connection.

However, one can grasp the story of public open spaces by understanding the full range of influences that shape the process, its history, policies, and key stakeholders (Carmona, 2014). In addition, a combination of outcomes and interactions between; the design, development of space/place in use, and management shapes the experience of space (Carmona, 2014).

2.1.1 The spatial index

Public open spaces are an essential aspect of sustainable urban development, which has not been given much attention in the literature and the global policy (UN-Habitat, 2015).

In cooperation with *Instituto Nazionale di Urbanistica* and other partners, the UN-Habitat and other partners have developed a public spaces toolkit; with actionable ideas on improving the availability, quality, and distribution of great public spaces. The toolkit is a selection of good practices compiled by experts: meant to inspire cities to develop, manage, and enjoy public spaces worldwide (UN-Habitat, 2015). The toolkit establishes the case for public spaces, the goals, constraints, principles, policies for public spaces, and ways of turning sound directions into actions. In addition, the public spaces tool kit establishes public spaces indicators; supply, quality, and distribution in cities. The study borrows spatial index attributes in mapping out public open spaces in Isiolo municipality.

2.1.2 The case of the open space system in Dodoma

The study identifies Dodoma's master plan as a case study; to elaborate on the distribution of public spaces in the design.

Like Isiolo in Kenya, Dodoma is at the heart of Tanzania and in a hot semi-arid climatic zone.

Dodoma development plan applies an open space system concept in tune with intelligent urbanism theory principles that guide the Kenya urban development policy.

The concept of the open space system entails using public spaces as the most dominant and guiding urban design element in Dodoma. The idea comprises two main components; nodes and linkages. Nodes are the larger open areas such as playing fields and parks, while linkages are pedestrian walkways and bicycle lanes.

The open spaces are conceived and laid out as a hierarchical system, ranging from the garden of a house and individual *shambas* to the great central Park and, indeed, to the region's agricultural areas and wildlife preserves. All these public open spaces are linked together into a unified urban totality.

See figures 2.1-2.3 on the following pages.

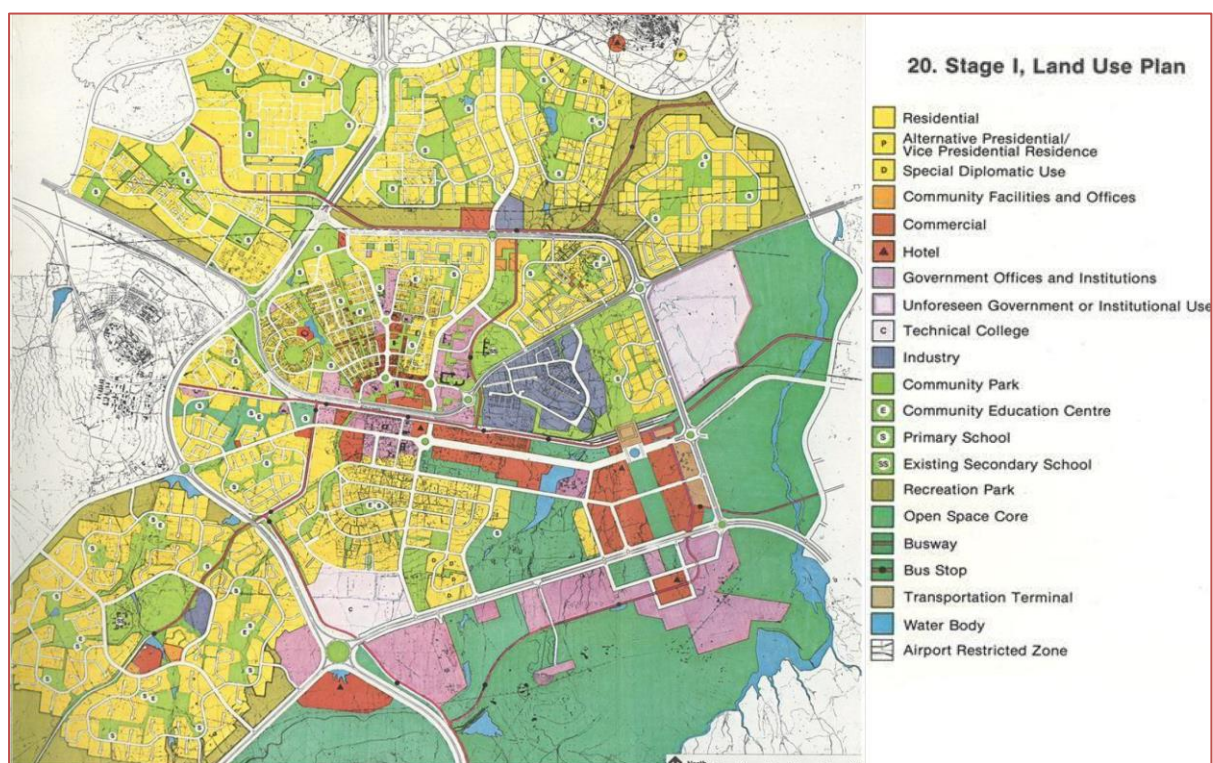


Figure 2.1: Dodoma Land use plan
Source: Hancock, 1976

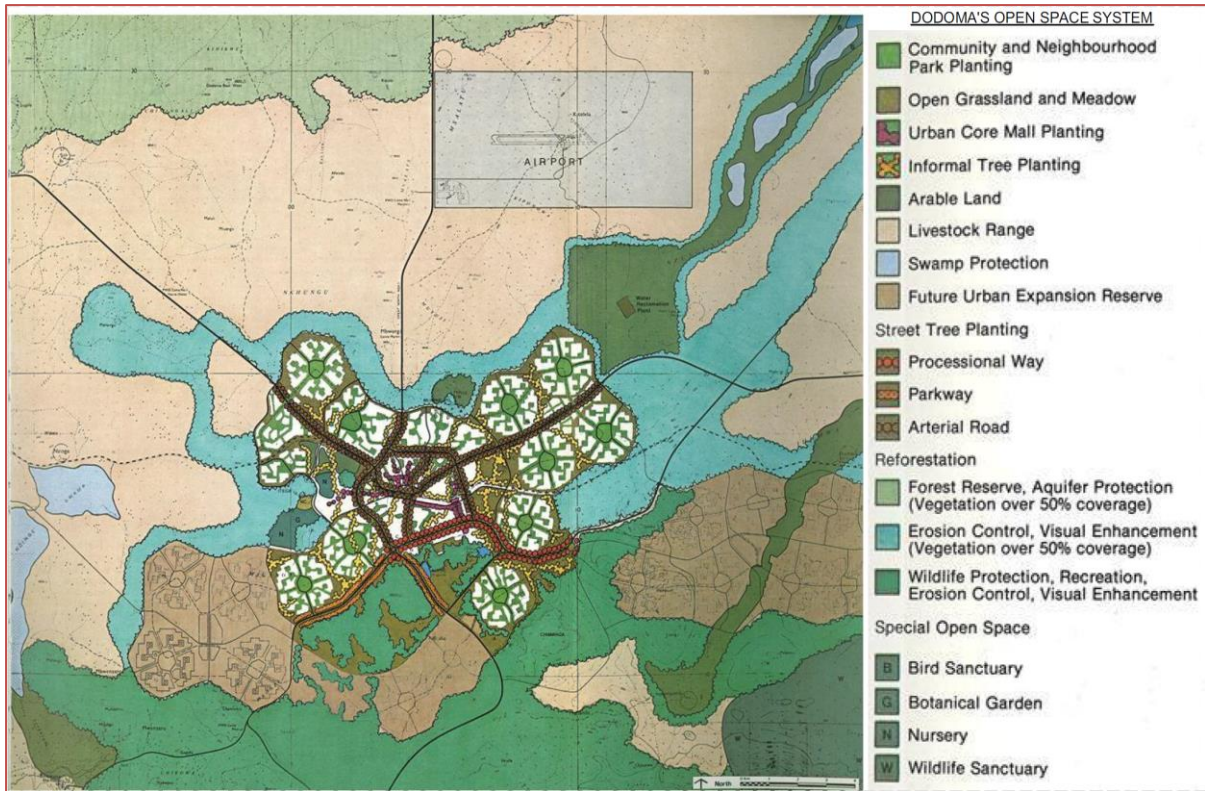


Figure 2.2: Dodoma's open space system
Source: Hancock, 1976

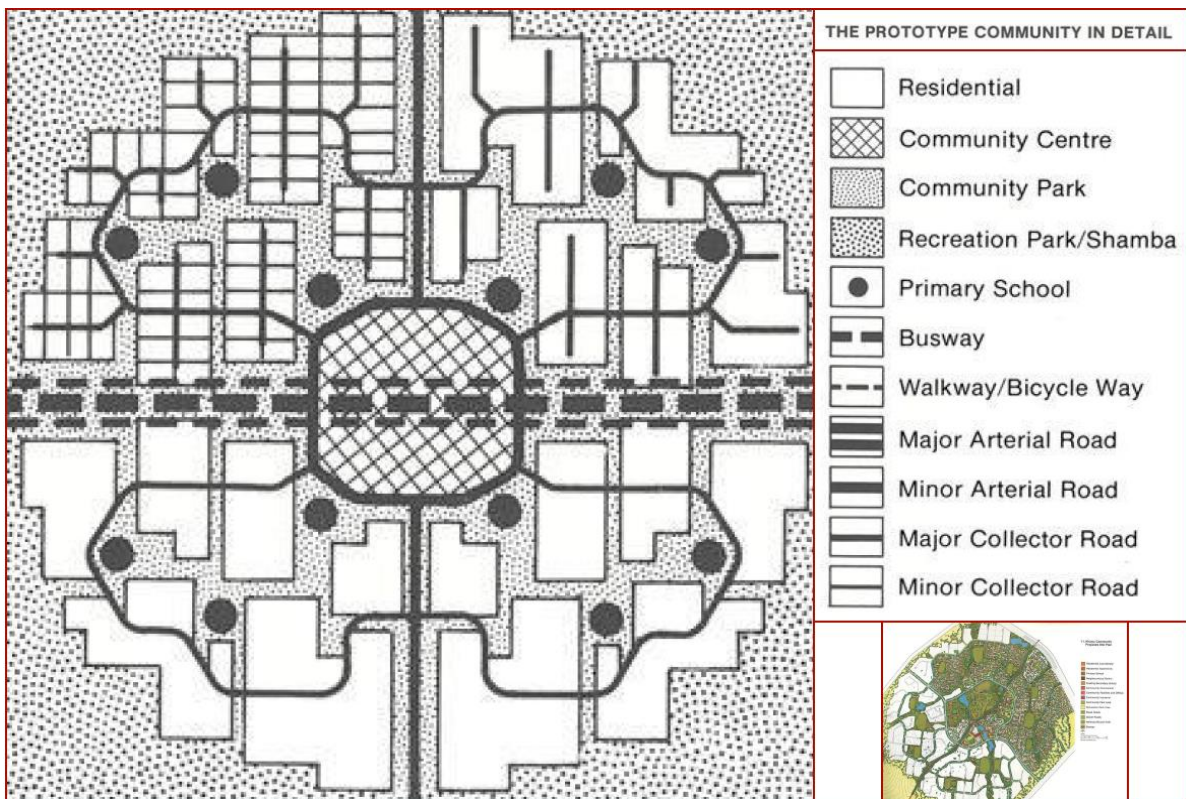


Figure 2.3: Open space system's Prototype
Source: Hancock, 1976



Figure 2.4: Google image of Dodoma

Source: Google maps, 2018

The implementation of the plan is ongoing.

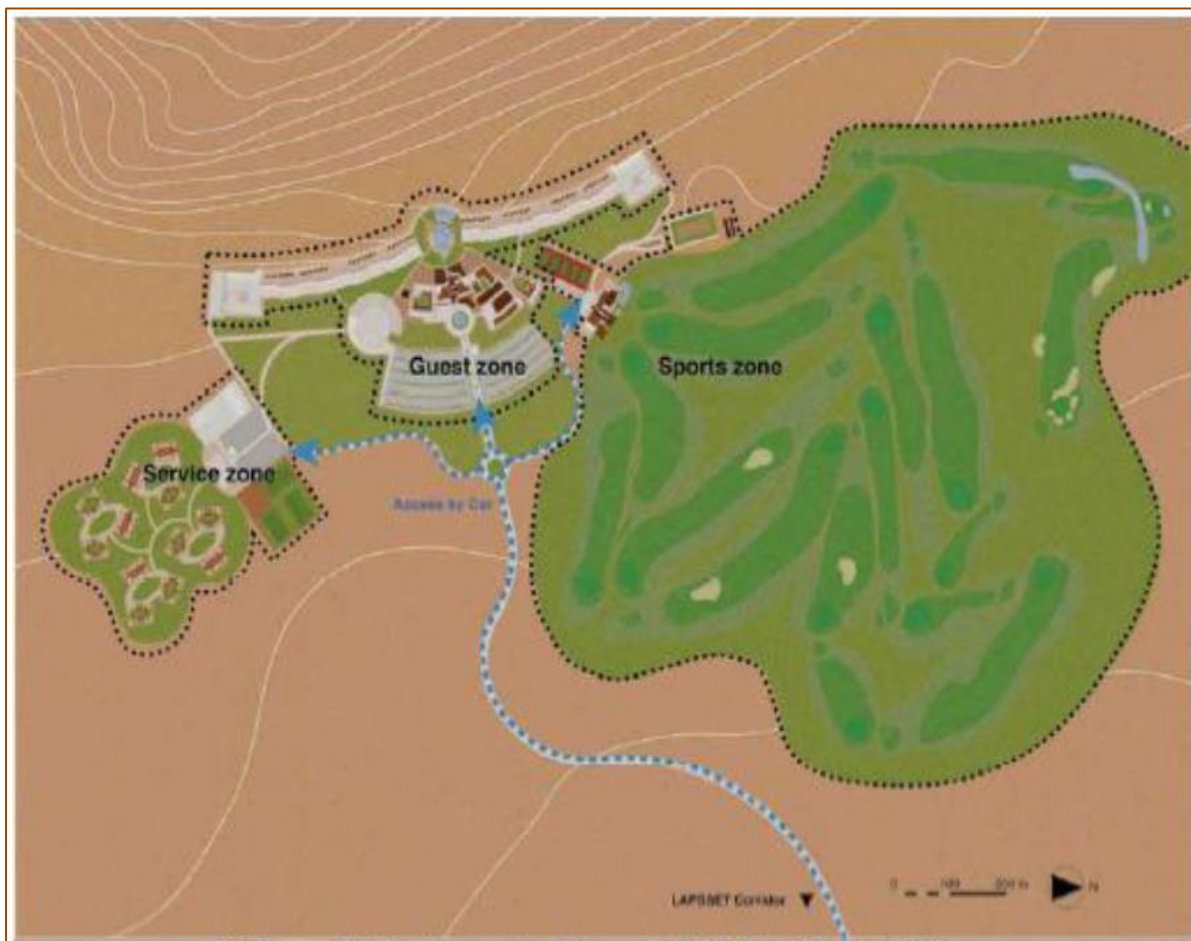


Figure 2.5: Conceptual layout of Isiolo municipality as resort city

Source: JPC, 2017

Lessons learned

Urban designers need to intervene and ensure public open spaces are allocated and distributed evenly at the development stages of land use plans. The study observes this as an essential step missed in the Isiolo municipality

The study views the outlined urban development policy as hardly implemented. Therefore, urban designers need to cascade the ten principles of intelligent urbanism to the five elements of urban design theory. The study views the proposed Isiolo resort city as anchored to existing natural features: game parks and game reserves, scenic hills, and cultures.

The study identifies design opportunities for artificial features like public open spaces to enhance the envisioned resort city. For example, figure 2.5 shows a golf course as a proposed artificial feature.

2.2 The utilization of public open spaces

The study applies known theories, concepts, and case studies to review the utilization of public open spaces. Theories reviewed are; the place-shaping continuum theory, principles of intelligent urbanism theory, dimensions of a public space design concept, the place-making concept, and environmental and sustainable design concepts.

The study identifies case studies that demonstrate these theories and concept on the one hand and are also relevant to public open spaces of Isiolo, and expound them as follows;

2.2.1 Principles of intelligent urbanism theory

The principles of intelligent urbanism developed by Christopher (2010) are the backbone of the National Urban Development Policy. The policy outlines public open spaces as a critical investment area in Kenya's urban social and economic infrastructure development. The ten principles are; balance with nature, balance with tradition; use of appropriate technology; conviviality; efficiency; human scale, opportunity matrix, regional integration, and institutional integrity. The study observes that Dodoma's master plan applies these ten principles.

2.2.2 Public open space design dimensions

The public open spaces design dimension derives from urban design dimensions developed by Matthew Carmona, Steve Tiesdell, Tim Heath, and Taner Oc (2010). The six dimensions of public open spaces design are; morphological, perceptual, social, visual, functional, and temporal. The concept is a comprehensive overview of public open spaces whose main

objective is to enhance the use of public open spaces. The study identifies the Jeevanjee garden as a valuable public space in Kenya that demonstrates enhanced use.

2.2.3 Place shaping continuum theory

Place shaping continuum theory explains the urban design process. The theory was developed in 2014 by Professor Mathew Carmona, following an investigation of the shaping of public open spaces in London. He concludes that public space design is a continuous place-shaping process. Therefore, public space design inputs are in value creation and shape constraints.

In Isiolo, her public open spaces should be helpful and the hot semi-arid climatic constraints mitigated by urban designers.

The place-shaping continuum theory highlights activities, associations, adaptation, and appropriation as the primary drivers of functional public open spaces.

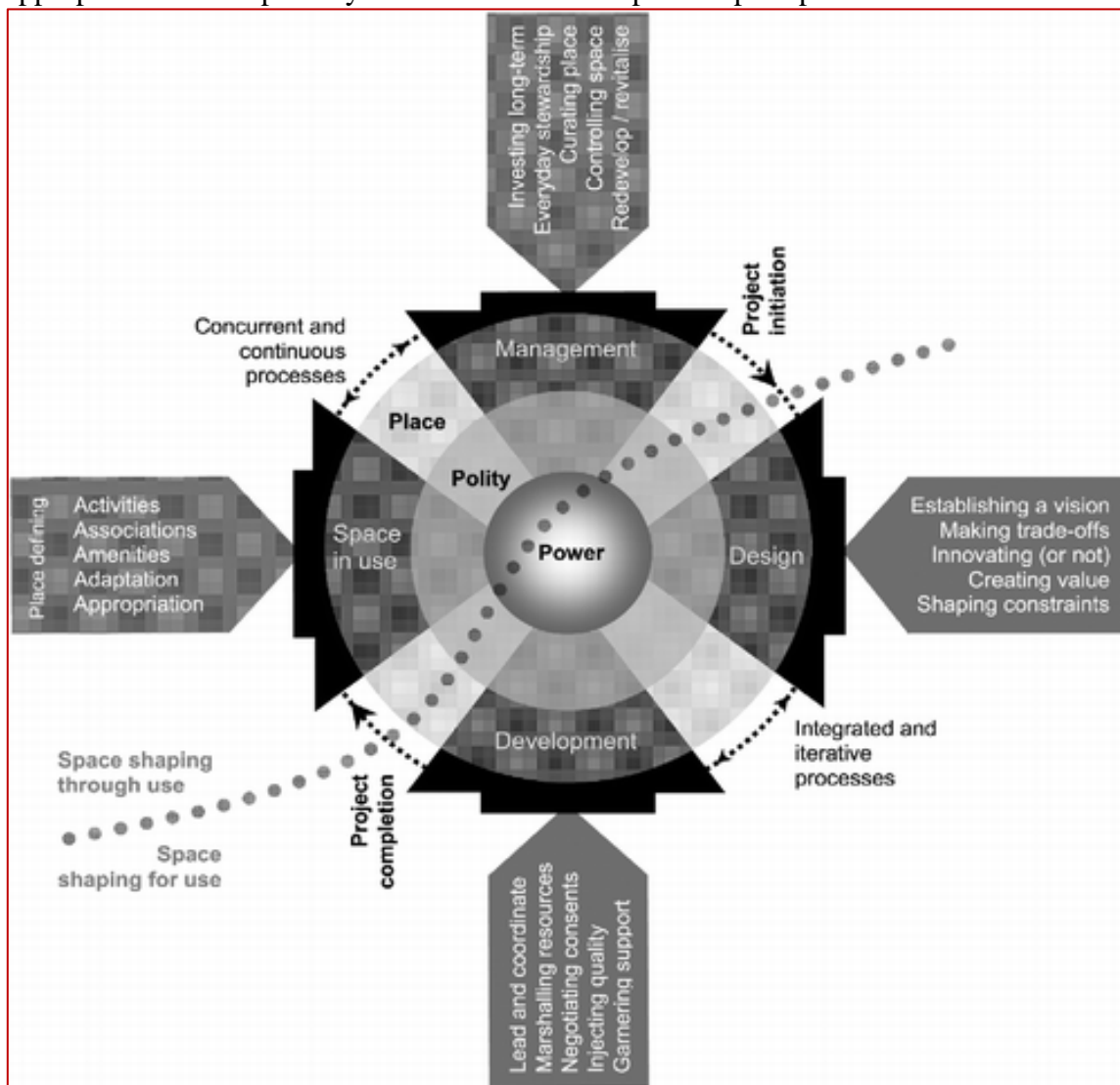


Figure 2.6: Urban design process: A place-shaping continuum.

Source: Carmona, 2014

2.2.4 Place making concept

The UN-Habitat 2016 defines place-making as a collaborative process of shaping the public realm to maximize shared values. Besides promoting better urban design, place-making facilitates creative use patterns, paying particular attention to the physical, cultural, and social identities that define a place and support its ongoing evolution.

Place-making focuses on how public spaces can contribute to sustainable urban development. The attributes of place-making are; use and activities, sociability; comfort and image; and access and linkages.

The study views both place-making and place-shaping discussed as similar as seen in their respective attributes. The outcome of both is the same: functional public open spaces.

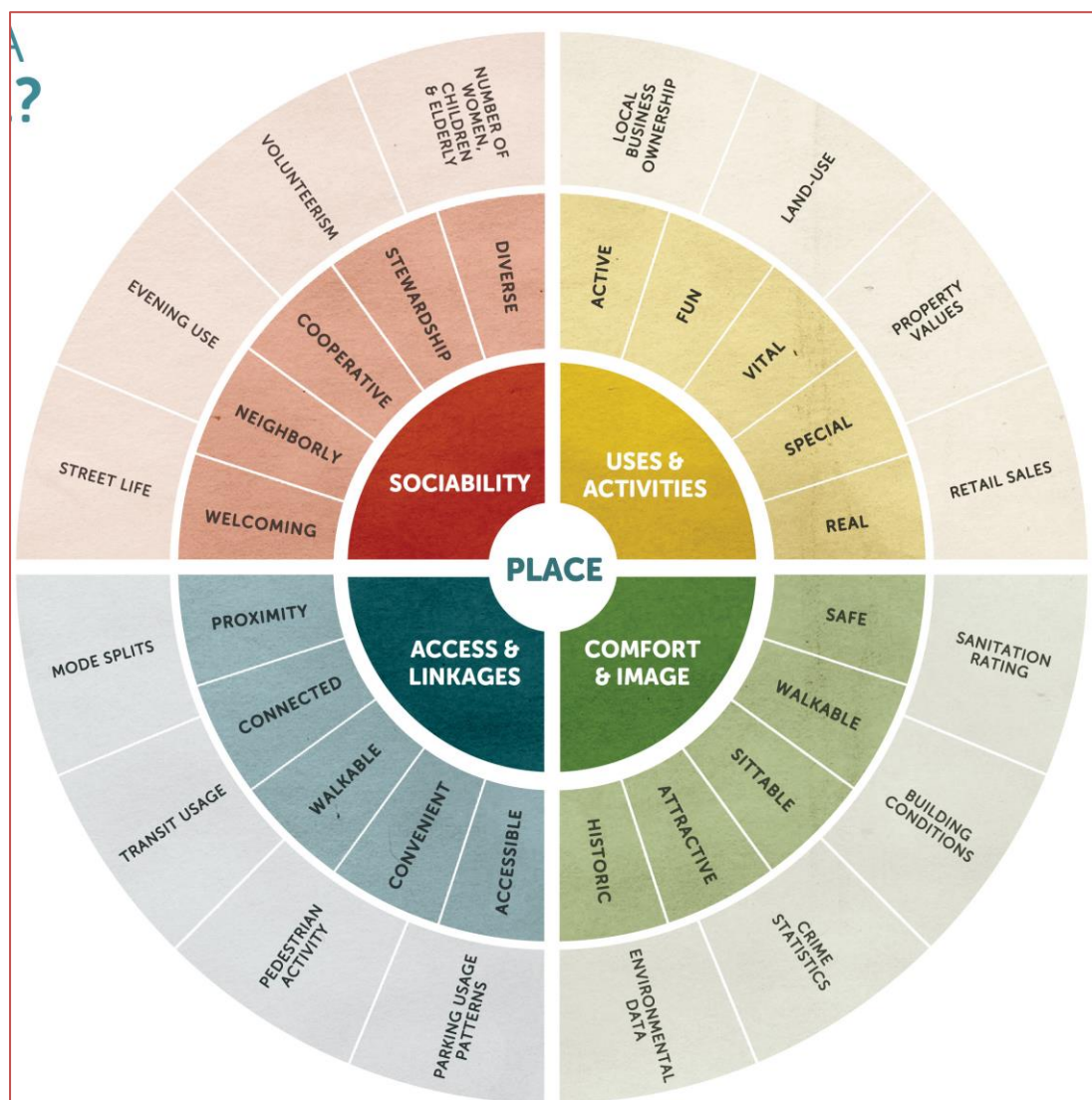


Figure 2.7: Place making concept
Source: Project for Public open spaces, 2014

2.2.5 Case of place-making at Jeevanjee garden in Nairobi

The reviewed theories and concepts advocate usable public open spaces. In Kenya, UN-Habitat identified the Jeevanjee garden as a pilot project when advancing the place-making concept. Therefore, the study selects the Jeevanjee garden case study to illustrate how an existing public open space can be optimized and guided by place-making.

Jeevanjee garden is a 5-acre public open space in Nairobi city; that was donated to the public by Alibhai Mullah Jeevanjee- An Asian-born entrepreneur in Kenya. In February 2014, the Nairobi City County, in cooperating with UN-Habitat, launched the place-making concept at Jeevanjee garden.



Figure 2.8: Proposed Layout of Jeevanjee gardens
Source: NCC, 2014

Project for public open spaces (PPS), New York, served as the technical facilitator of the project.

The main objective was to improve delivery and access at Jeevanjee gardens, especially for less favored Nairobi residents, and demonstrate how to design, implement and manage public open spaces while engaging the community and civil society in all processes. Therefore, emphasizing on participatory approach to design. The interventions made touched on; entry points, water points, exhibition area, children's play area, and sitting area as demonstrated as follows;

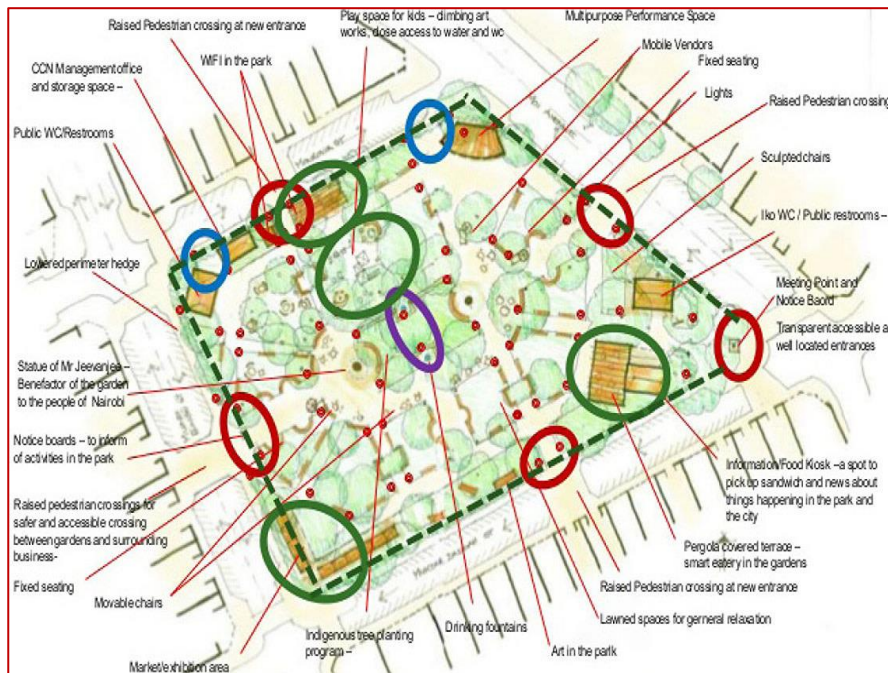


Figure 2.9: Proposed layout of improved Jeevanjee garden

Source: NCC, 2014

a) Entrances

The Place-making concept proposed a raised pedestrian crossing at existing and new entry points. The gates have a perimeter hedge. See figures 2.10-12.

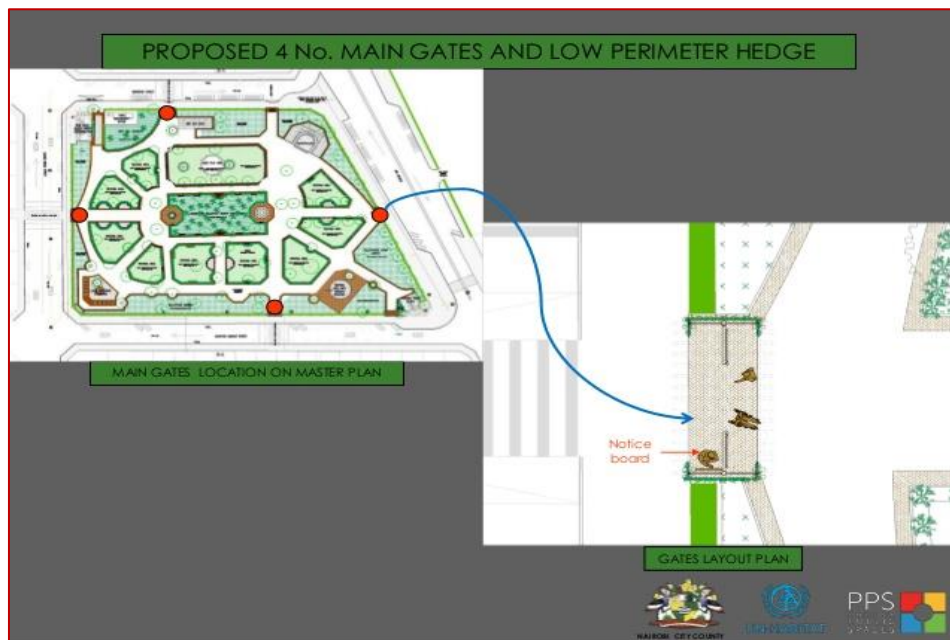


Figure 2.10: layout of Proposed Gates
Source: NCC, 2014



Figure 2.11: old gate and pedestrian crossing pads
Source: NCC, 2014



Figure 2.12: image of the new developed gate
 Source: Author, 2018

b) Water points

The Place-making concept proposed two water points at the center of Jeevanjee gardens, which serve both kids and adults. See figures 2.13-14.

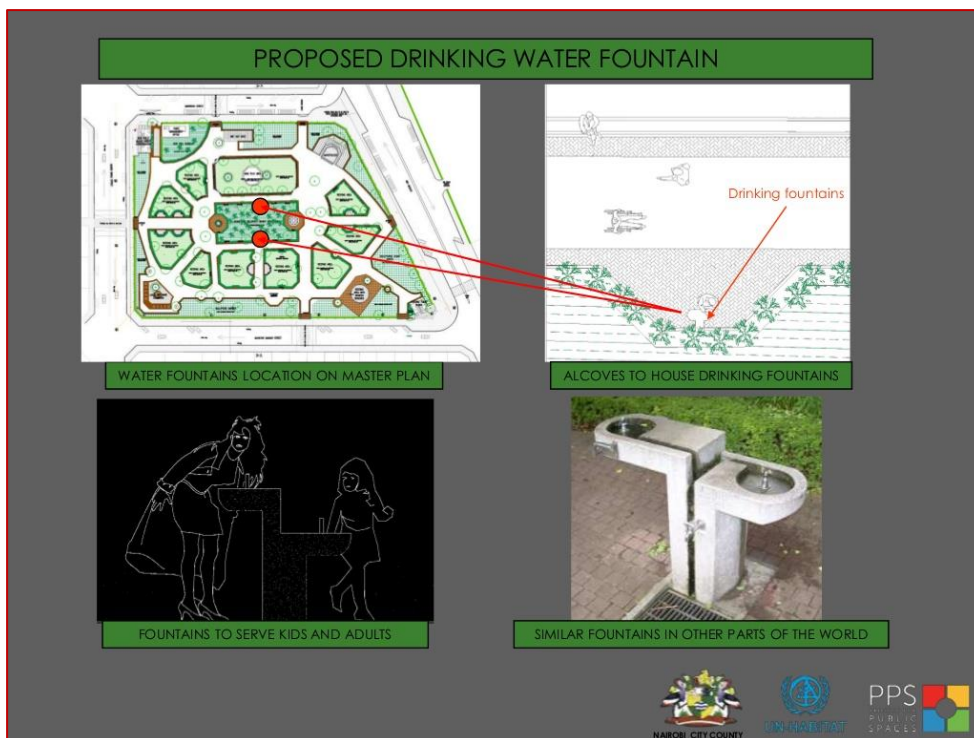


Figure 2.13: Proposed water points at Jeevanjee
 Source: NCC, 2014



Figure 2.14: Undeveloped water points at Jeevanjee
Source: Author, 2018

c) Exhibition area

The place-making concept proposed an intermittent local arts stall at one of the corners of Jeevanjee gardens, replacing the existing smoking zone. See figures 2.15-17.



Figure 2.15: layout of proposed exhibition stalls
Source: NCC, 2014



Figure 2.16: Proposed exhibition stalls
Source: NCC, 2014



Figure 2.17: Undeveloped Exhibition stalls
Source: Author, 2018

d) Children's play area

The place-making concept proposed an area for children to improve on Jeevanjee by making it more inclusive. See figures 2.18-20.

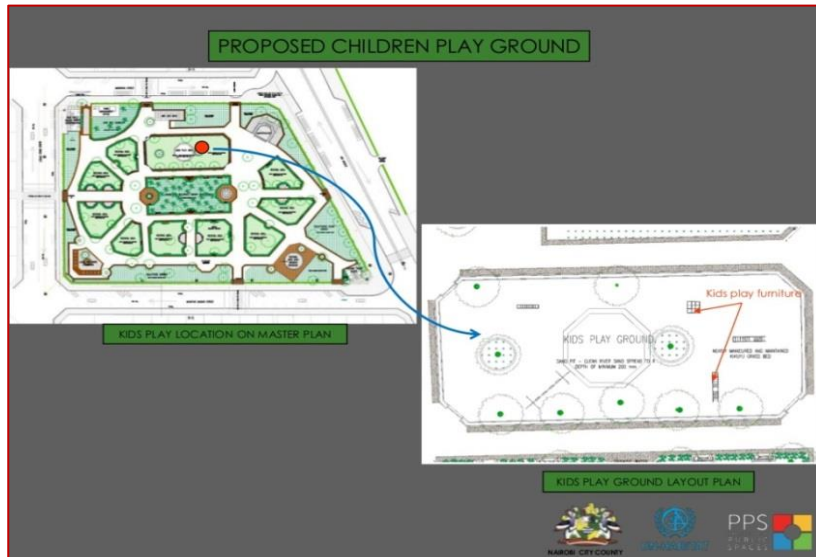


Figure 2.18: layout of proposed children playing ground
Source: NCC, 2014



Figure 2.19: proposed children play ground
Source: NCC, 2014



Figure 2.20: Undeveloped children play ground
Source: Author, 2018

e) Sitting area

The place-making concept proposed a shaded seating area and thus a pergola with seats around. See figures 2.21-23

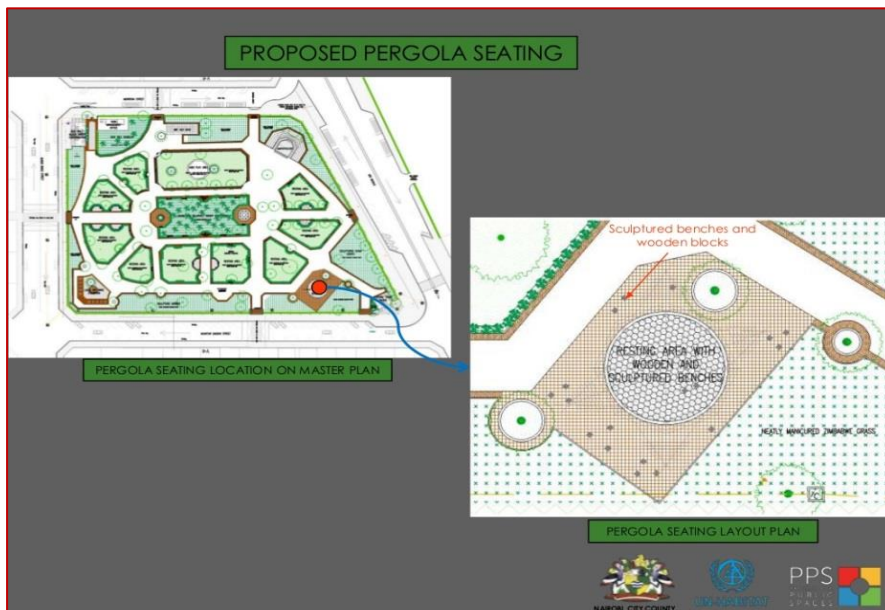


Figure 2.21: layout of proposed pergola
Source: NCC, 2014



Figure 2.22: proposed pergola
Source: NCC, 2014



Figure 2.23: Undeveloped sitting area
Source: Author, 2018

f) Lessons learned

There is a need to continue shaping constraints in public open spaces to make them useful. For example, at Jeevanjee gardens, discomfort as a constraint is shaped by providing shaded sitting areas, a key learning point to Isiolo where there is a need for human comfort in her public open spaces. See figures 2.24. A pedestrian crossing is introduced at Jeevanjee garden to enhance accessibility, as Public open spaces should not be restrictive either by design or through conduct

The water points enhance amenities and improve perceived comfort.

Amenities are essential in public open spaces as they dictate the use and attract users.

An exhibition is introduced at Jeevanjee garden to enhance amenities and replaces the smoking zone, implying that designers should be critical when proposing amenities in public open spaces. In addition, a children's playground is introduced at Jeevanjee garden to enhance inclusivity, reminding designers of the need to have inclusive and active public open spaces.

Public open spaces at Isiolo lack the listed attributes that make them valid and thus, the constraints shaped, and the open spaces made great places.



Figure 2.24: Jacaranda tree at Jeevanjee Gardens

Source: NCC, 2014

2.2.6 Environmental design concept

Environmental design is one of the five attributes of functional dimension and an essential part of public open space design. There is a need to provide comfortable conditions within public open spaces (Carmona, 2014).

The main goal of environmental design is to reduce uncomfortable conditions created by extremes of heat and dryness; By minimizing heat gain during daytime and maximizing heat loss at night in hot seasons; through a reverse in cold seasons: minimizing internal heat gain in the hot season; selecting the site according to microclimatic criteria; optimizing the building structure; controlling solar radiation and regulating air circulation (Gut & Ackerknecht, 1993).

A significant component of environmental design is the prevailing climatic conditions, as they influence comfort. Climate is composed of; solar radiation, glare, temperature, precipitation, humidity, air movement, air pollution, and sand and dust (Gut & Ackerknecht, 1993).

According to Hooper (1975), air temperature, sunshine and radiation, humidity and rainfall, winds, and microclimates constitute climates. According to UN-Habitat (2014), solar radiation, air temperature, relative humidity, and wind are the main climatic parameters bearing on energy.

Therefore, a review of the above reveals the climatic parameters in public open spaces design as; solar radiation, temperature, wind, air movement, relative humidity, precipitation, microclimate, pollution, location, and hazards.

Planning in hot semi-arid, Hooper 1975 notes that; significant attention is on drainage and shading of outdoor spaces. Therefore, for Isiolo municipality, the focus should be on solar radiation, temperature, wind and air movement, hazards-strong winds, floods, sand, and dust. Not that; hedges and other vegetation should be planted in hot semi-arid climates to reduce dust, glare, and reflected heat (UN-Habitat, 2014).

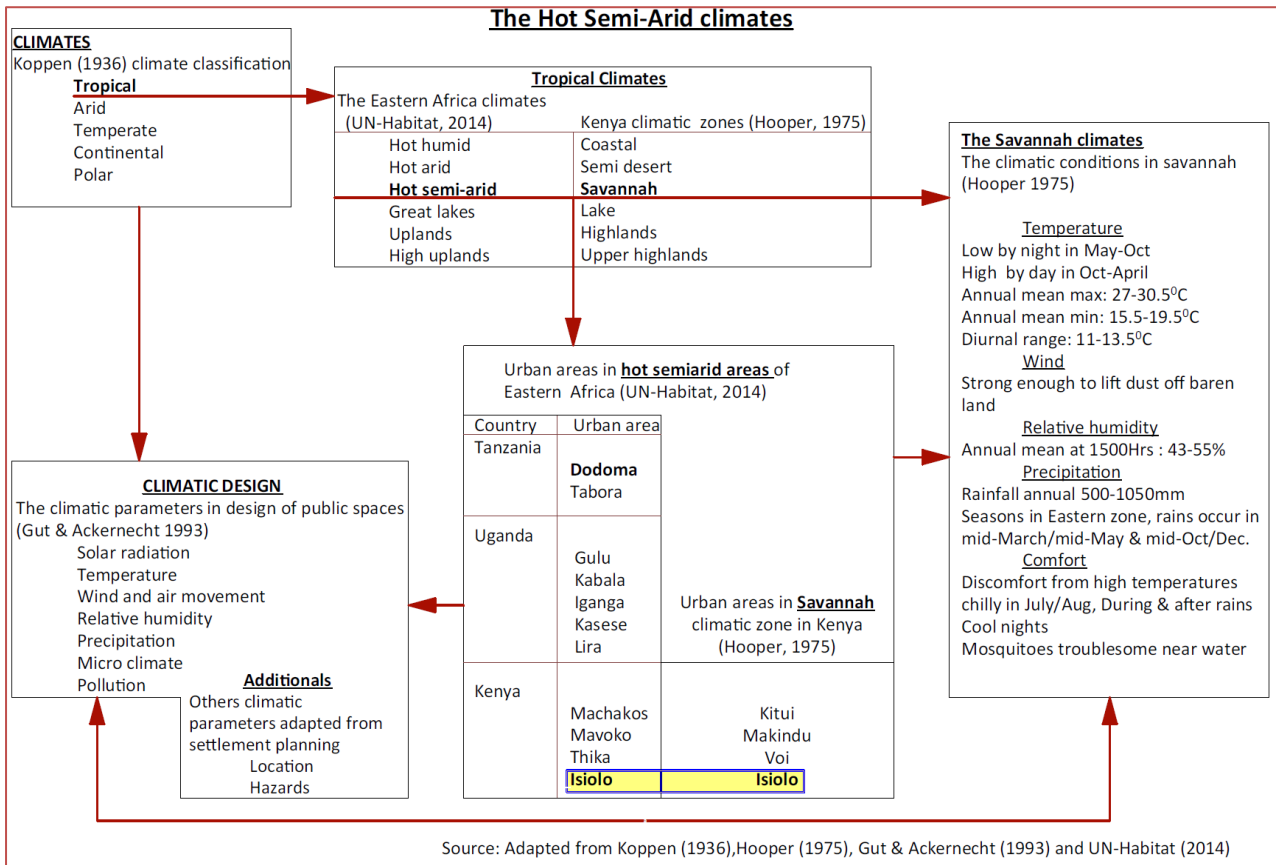


Figure 2.25: Description of hot semi-arid climates.

Source: Adapted from Koppen (1986), Hooper (1975), Gut & Ackernecht (1993), and UN-Habitat (2014)

2.2.7 Sustainable design concepts

UN-habitat (2014) has a range of sustainable design measures for tropical climates in Eastern Africa.

A climate responsive design approach and integrated design are essential during the design of public open spaces. The climate responsive design entails taking advantage of local climatic resources to provide a comfortable environment. For example, outdoor spaces in hot semi-arid climates need to be shaded by tall vegetation, breaking the wind and protecting the user from dust.

UN-Habitat (2014) recommends using vegetation of compatible height to cool incoming breezes: green borders.

In addition, the basic rule for orientation is: to minimize facades facing east and west; and to consider local prevailing winds as they influence natural ventilation (UN-Habitat, 2014). Trees of high canopies should be used in open spaces to maximize the cooling effect of wind, while bushes should be away from buildings (figure 2.20).

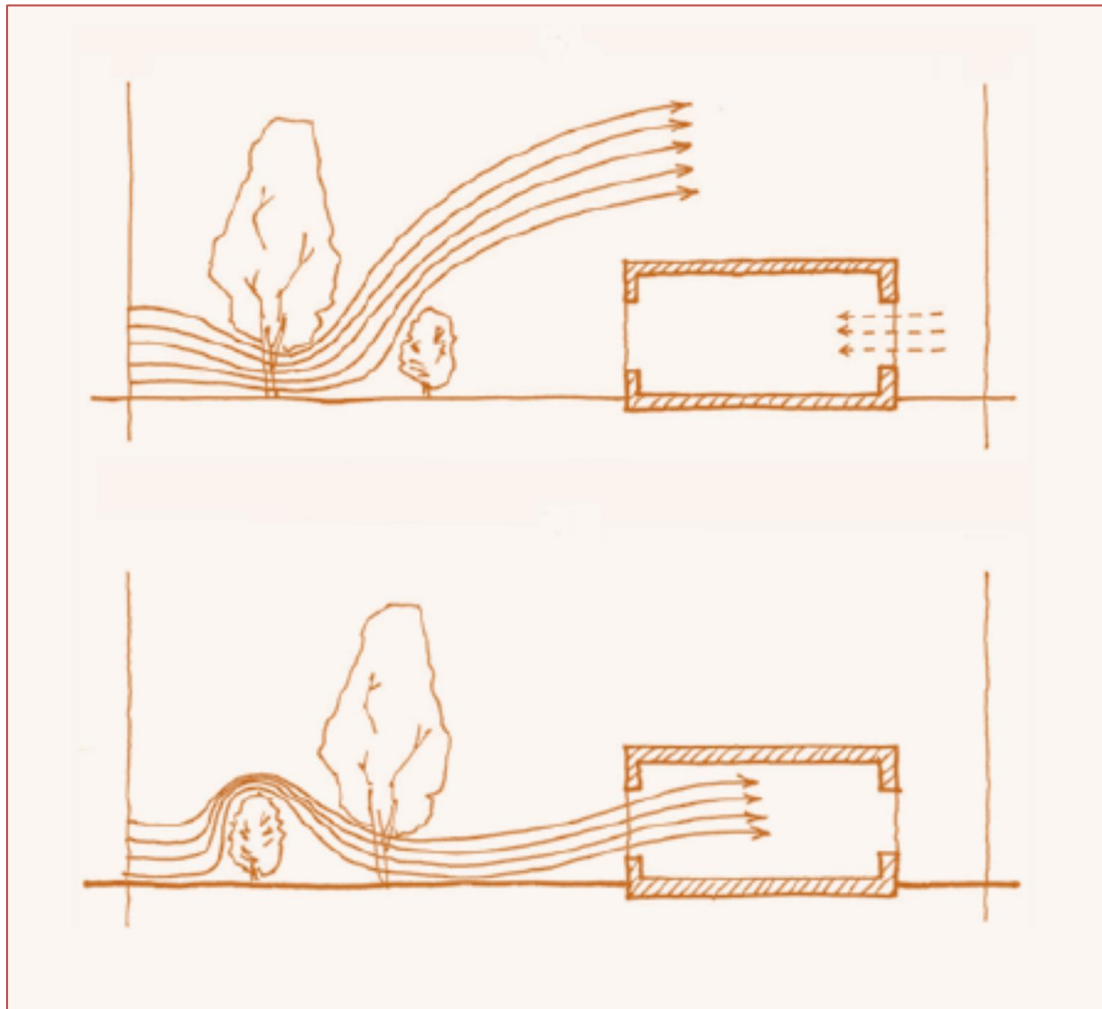


Figure 2.26: Cooling effect of wind
Source: UN-Habitat, 2014

An Integrated design proposes including an energy expert in the design team at the onset of design. UN-Habitat (2014) advocates the incorporation of efficient energy systems at the urban design stage. At this stage, maximum effort must minimize the energy needed to provide high thermal and visual comfort levels by appropriate design (UN-Habitat, 2014).

UN-Habitat (2014) cited that outdoor climate mitigation improves public open spaces' comfort by mitigating environmental conditions. For example, in hot and dry climates like hot semi-arid climates, mitigation is by green shading. Green shading entails using wastewater purified and used to cool open spaces and water trees for shading these spaces. In

addition, a grid of mitigated environmental paths provides enhanced walking whereby paths are excellent and shaded (UN-Habitat, 2014).

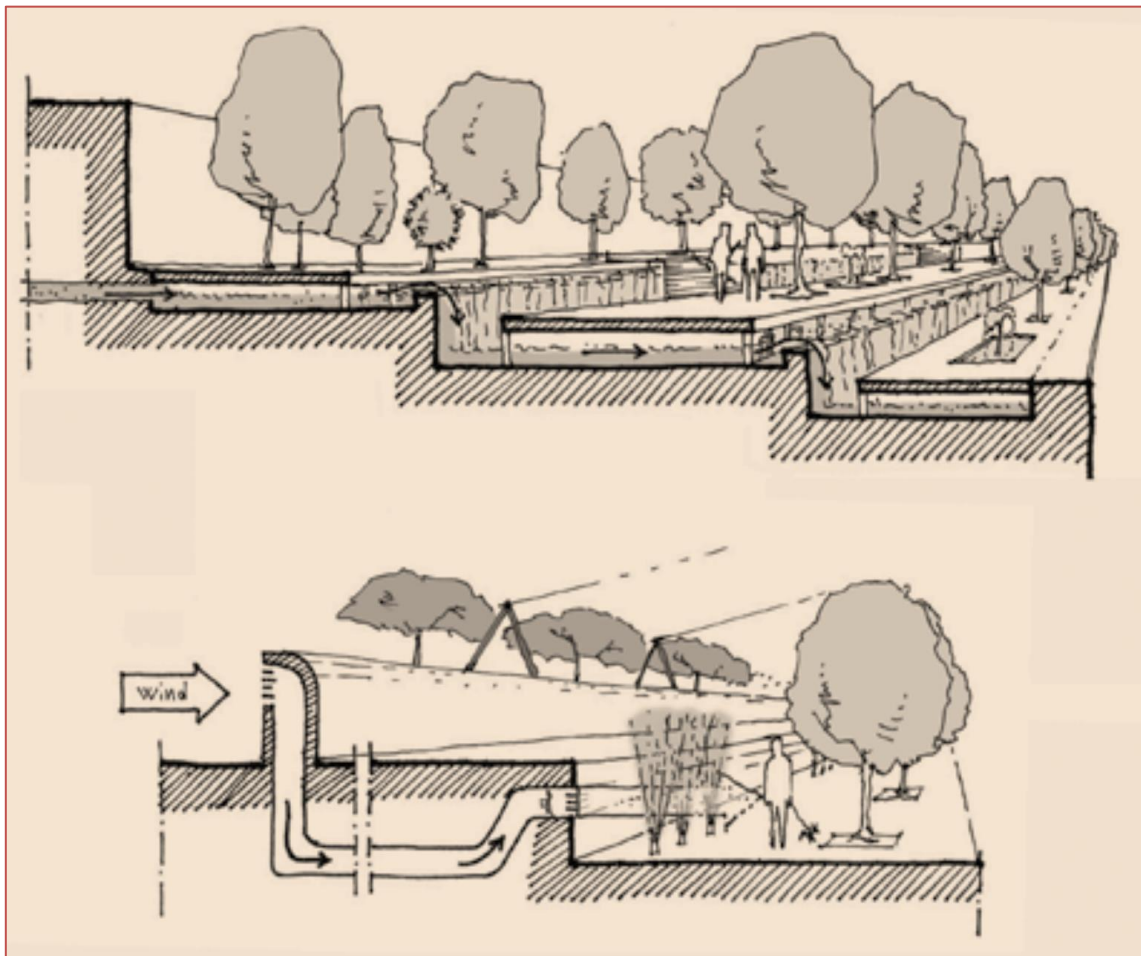


Figure 2.27: Outdoor climate mitigation

Source: UN-Habitat, 2014

Isiolo municipality experiences strong winds, which necessitates windbreakers and shelterbelts. The design of windbreakers and shelterbelts is from good agricultural practices that protect crop fields from solid winds. See figures 2.22 and 2.23.

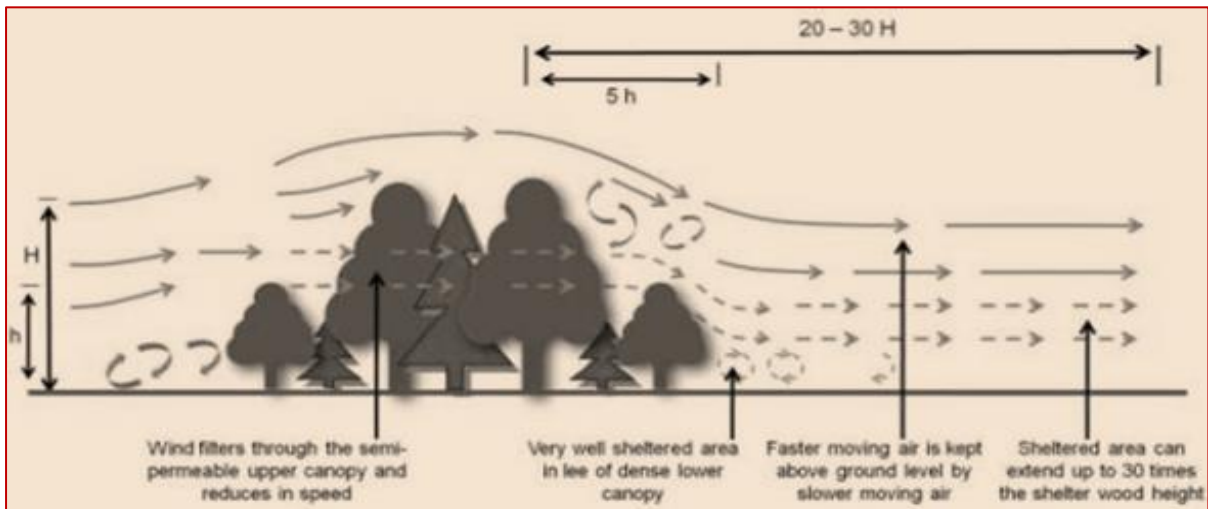


Figure 2.28: wind break and shelterbelt design
Source: University of Hertfordshire, 2011

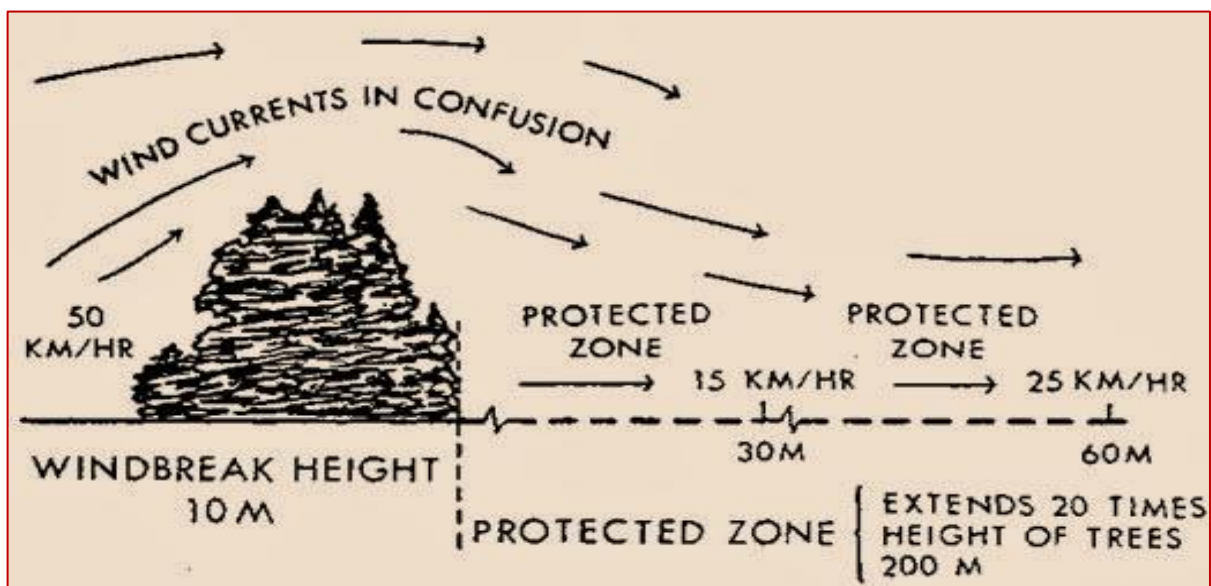


Figure 2.29: wind break design
Source: Balkan ecology, 2013

There are several sustainable concepts reviewed that derive their name from their core function. These concepts are water conservation and sustainable drainage concepts as advanced by UN-Habitat (2014); the green infrastructure as advocated by EPA (2009); the xeriscaping concept as explained by Christopher (2011), the shadow umbrella concept developed by Rahinton (2010), and vernacular concept as reviewed by UNEP (1999).

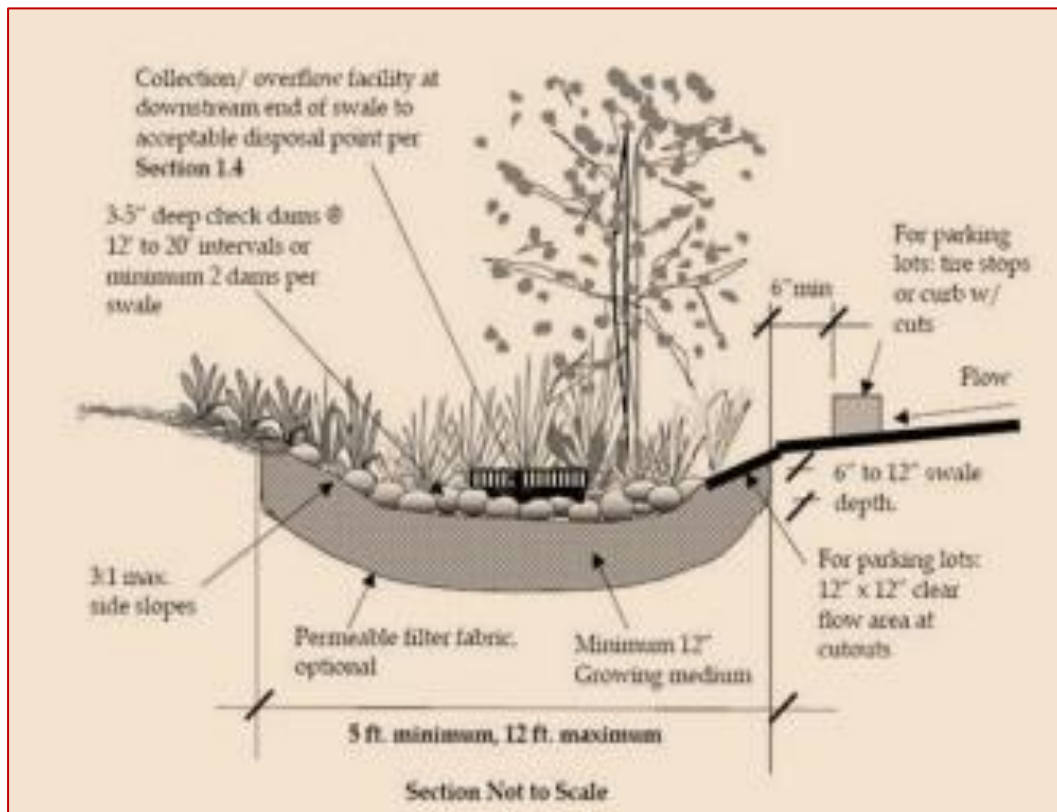


Figure 2.30: A cross-section of a sustainable drainage system:

Source: Source: Pinterest, 2018

2.2.8 Case study on sustainable public open space: The Civic space in Phoenix, Arizona

Having reviewed a valuable public open space in Kenya, the study also reviews a sustainable public open space in a hot and dry area. Finally, it identifies the Civic space in Phoenix, Arizona.

The civic space park is a 2.7-acre Urban Park that provides a unique urban design setting; through its sustainable construction through intelligent urban design, green space, multiple shade structures, interactive LED lighting, and low carbon design.

The sustainable park features include solar panels, trees to shade, pervious concrete on hard surfaces, and pavers that reduce heat reflection. Pervious concrete allows rainfall to seep through, thus mitigating storm water runoff. Trees are planted with a system that utilizes grates and specially engineered soils to protect roots and minimize compaction thus allowing ample room for root expansion; most of these trees are deciduous to take advantage of Arizona.

The Park has immediate access to light rail and bus transit stations, located just 30m from the Park; therefore, it encourages pedestrian visitation and mass transit; finally, the Park has zero parking spaces.



*Figure 2.31: Aerial view of civic space in Phoenix, Arizona
World landscape architect, 2013*

Lessons learned

The design of public open spaces in the hot semi-arid can offer a new kind of urban typology; achieved through sustainable construction, as seen at Civic space in Arizona: a great example of how the use of trees and solar panels to shade open spaces and provide a platform for social interactions.

The Civic space applies sustainable drainage, and lawns are used for heat reflection, an excellent lesson for public open spaces in Isiolo municipality



*Figure 2.32: A lawn and shaded areas
World landscape architect, 2013*

Conclusions

The public space spatial index can be applied to map out public open spaces in an urban area.

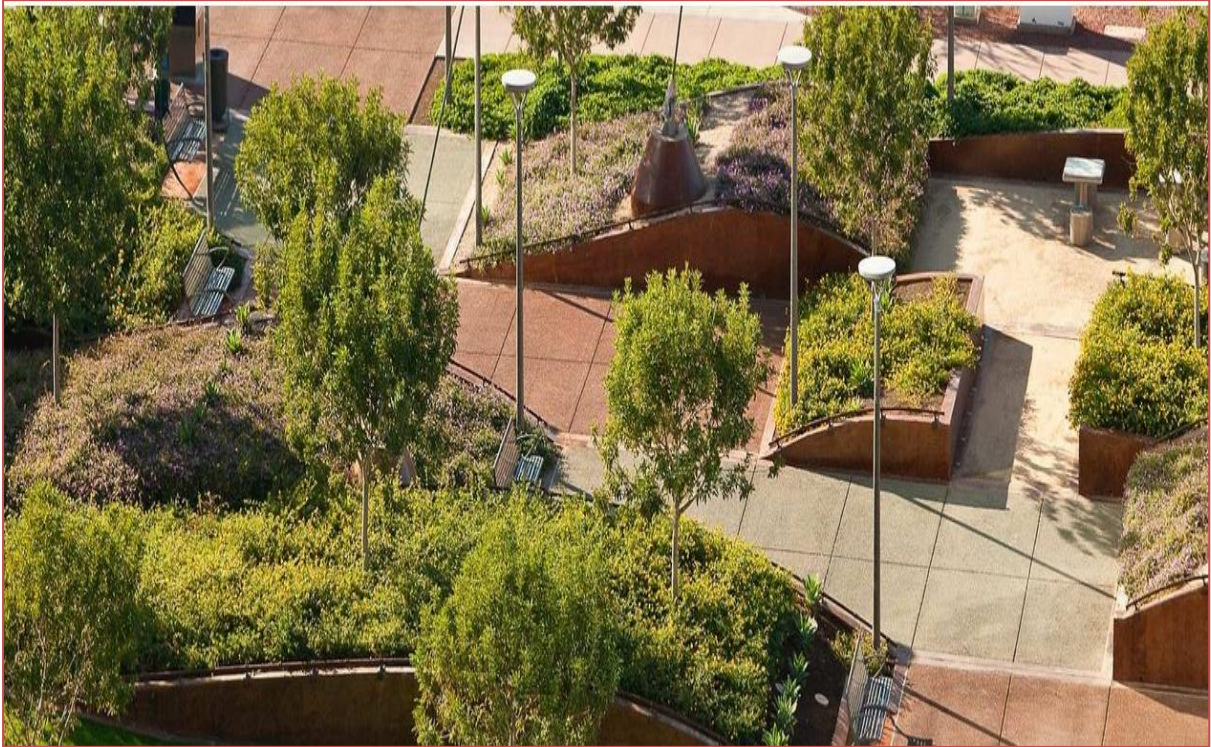
For example, in developing the resort city at Isiolo, Dodoma's open space system can be borrowed to enhance public open spaces and guide the national development policy

The public open spaces ought to be valuable and sustainable, especially in hot semi-arid climates. Available concepts ranging from dimensional to place-shaping to place-making concepts like those seen at Jeevanjee garden can enhance them.

However, it is also important to shape the climatic constraints, especially in the hot semi-arid, limiting public open spaces.

Shaping constraints can be done by observing climatic parameters in the design and applying available sustainable concepts observed at Civic space in Phoenix-Arizona.

Figure 2.34 on page 36 summarizes how the author links the reviewed theories and concepts with selected case studies.



*Figure 2.33: Porous paving and landscape
World landscape architect, 2013*

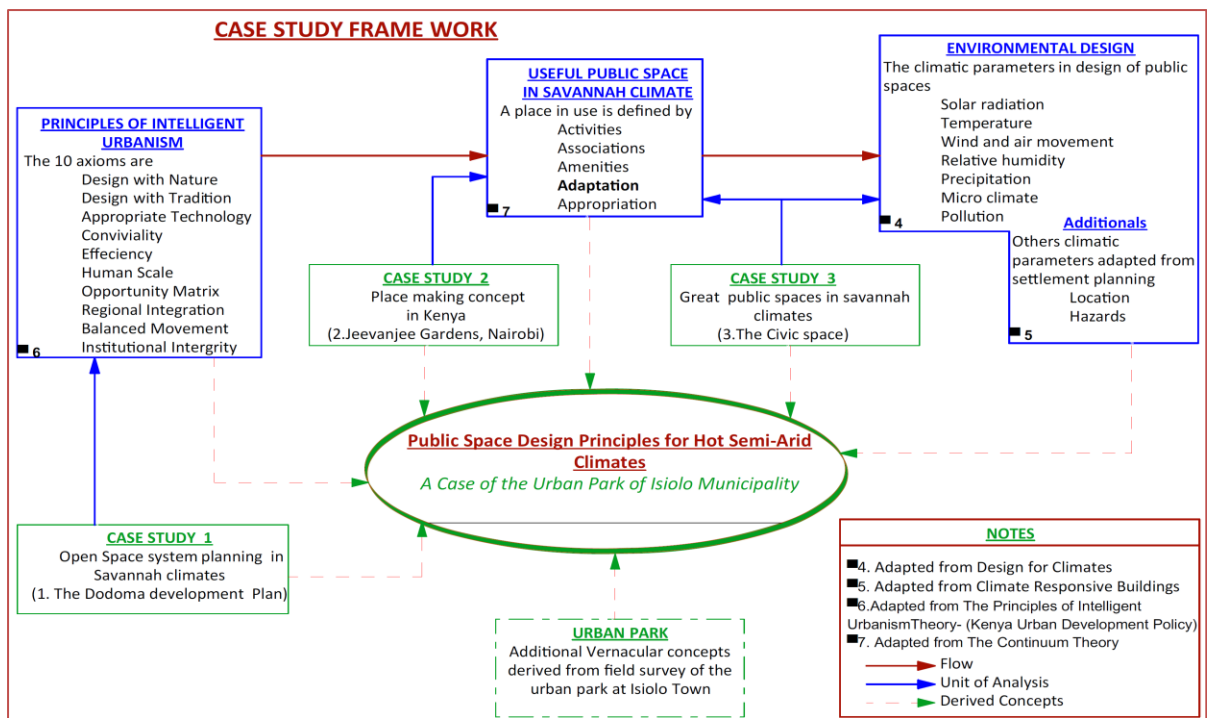


Figure 2.34: Case study framework
 Source: Author, 2018.

CHAPTER III- RESEARCH METHODS

3.0 Introduction

Research methods are theoretical procedures and statistical approaches used to help researchers collect samples and data and find a solution (Rukwaro, 2016).

Research methodology is a systematic, theoretical analysis of the procedures applied to a field of study (Kothari, 2004). Research methodology for the study entailed; research design, research approach, sampling design, data collection instruments, and data analysis.

3.1 Research design

Research design is a plan, a roadmap, and a blueprint strategy for finding answers to research questions; the heart of the study (Kothari, 2004). The study is descriptive; the primary purpose of descriptive research is to describe the current state of affairs (Kothari, 2004). First, the study describes the existing conditions and later describes possible solutions aided by case studies.

The study is exploratory, and therefore a survey, survey research is both descriptive and exploratory. The study explores public open spaces design theories, the climatic conditions that designers should focus on, and possible mitigation measures applicable to the design of public open spaces.

The study adopts a field survey which is probably the best method for collecting original data that is too large to observe directly (Mugenda & Mugenda, 1999).

3.2 Sampling design

To identify where the population to be studied is, maps and other geographical means should be used (Rukwaro, 2016). The study applies maps and development plans in identifying the location of the population to be studied

Purposive sampling is a sampling technique that allows a researcher to use cases that have the required information regarding the objectives of his/her study and get the location or district in which the units of observation have required characteristics (Mugenda & Mugenda, 2009). For example, the author used purposive sampling in identifying Isiolo municipality, a primary strategic node in Kenya's hot semi-arid.

See figure 3.1 on Kenya's main corridors and figure 3.2 on climatic zones in Kenya

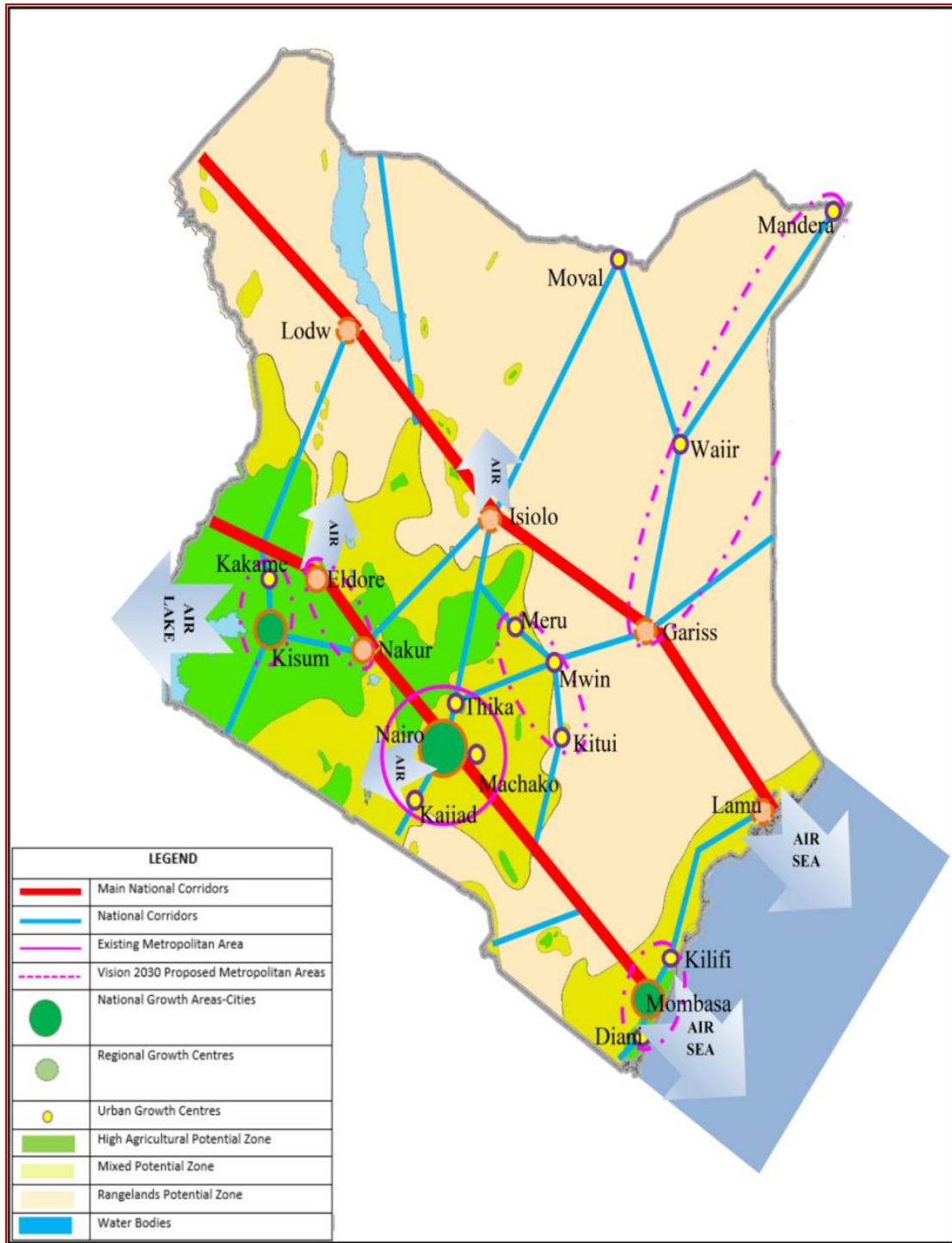


Figure 3.1: Map showing Kenya's main corridors

Source: KNSP, 2016

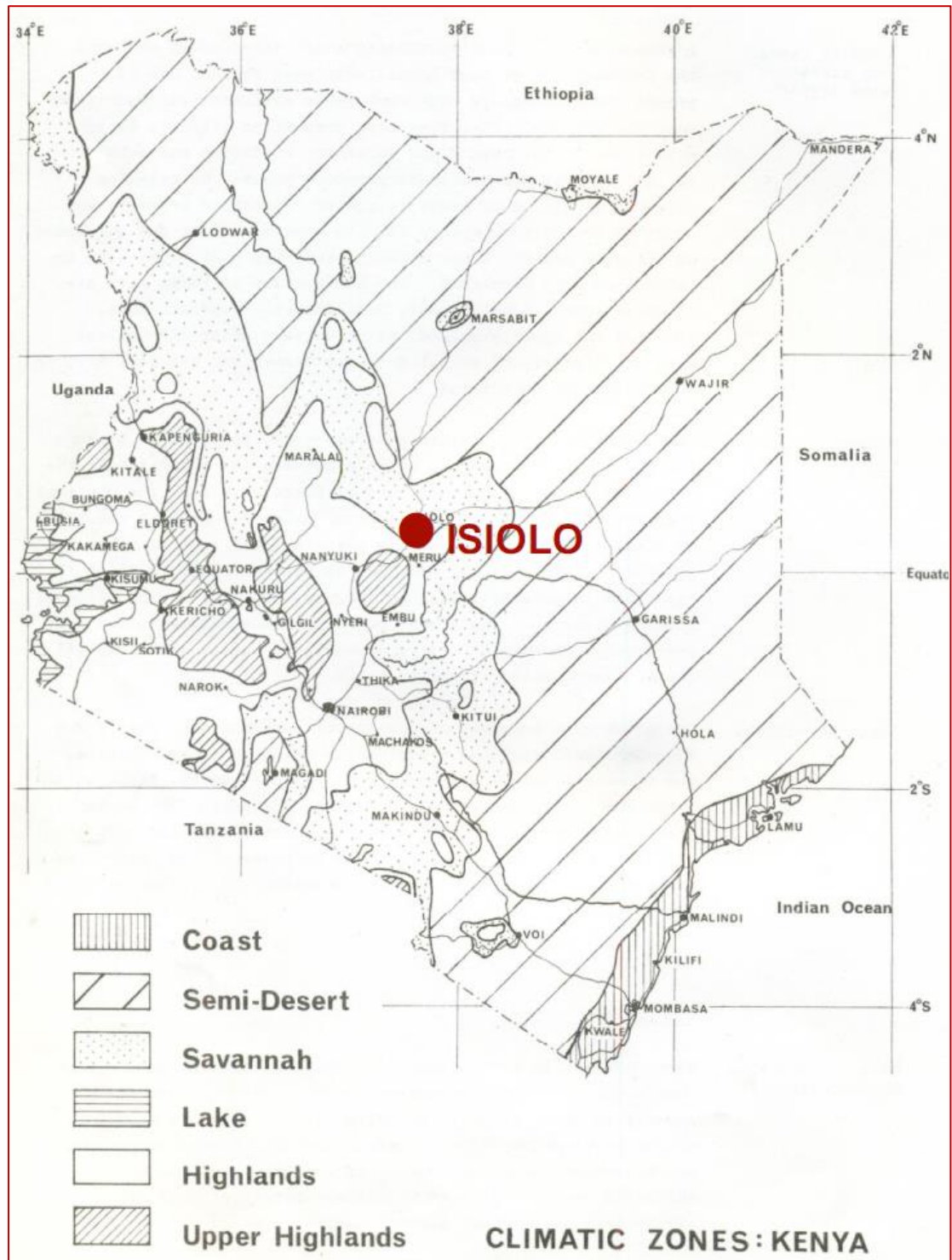


Figure 3.2 Map showing Kenya's climatic zones
 Source: Hooper, 1975

3.2.1 Unit of analysis

The unit of analysis is the element whose data is aggregated and analyzed in a study to make conclusions, decisions, or inferences (Mugenda & Mugenda, 2012). In mapping and documenting the public open spaces in Isiolo municipality, the study focuses on the supply and distribution of public open spaces established by UN-Habitat (2015) and benchmarked with Dodoma. See table 3.1 below;

Table 3.1: The supply, quality, and distribution of public open spaces

Indicators	Supply	Quality	Distribution
Public open Spaces	The surface area over the total town population	Park maintenance budget per inhabitant	The surface over-population of the selected quadrant
			City quadrant/total city ratio
			The proportion of population farther away than 200-300m from a city park,
			The proportion of the population farther away than 200-300m from a quadrant
			The proportion of population city quadrant/total city ratio.

Source: Adapted from UN-Habitat (2015)

The appropriateness of public open spaces in Isiolo municipality is through identifying their usability and sustainability. Hence, measurable parameters in the place making concept, as demonstrated at Jeevanjee gardens, are borrowed to analyze usability.

Table 3.2 highlights the measurable parameters recommended by UN-Habitat (2016) while advancing the place-making concept.

Table 3.2: Useful public open space indicators

Useful public open spaces	Indicators	Essential Questions /areas to observe/analyze
Use and Activities	Active spaces, Fun full, Vital, Special & Real	1. Are people using the public open spaces, or are they empty?
		2. Do people of different ages use them?
		3. How many different types of activities are occurring at one time? (For example, people walking, eating, playing, relaxing, or reading?)
		4. Identify which parts of the spaces are in use and which are not?
		5. Is there a presence of management? Or can one identify anyone in charge of the space?
Sociability	Diverse, Stewardship, Cooperative, Neighborhoodly & Welcoming	1. Is this a place where one would choose to meet a friend? Are others meeting friends here?
		2. Are people in groups? Are they talking with one another? Do they talk to people in other groups?
		3. Do people seem to know each other by face or by name?
		4. Do people bring their friends and relatives to see the place? Do they point to its features with pride?
		5. Are people smiling? Do people make regular eye contact with each other?
		6. Do many people use the place frequently
		7. Does the mix of ages and ethnic groups generally reflect the community at large?
		8. Do people tend to pick up litter when they see it?

Source: Adapted from UN-Habitat (2016), NCG (2014), and PPS (2012)

Table 3.2: Useful public open space indicators

Useful spaces	Indicators	Essential Questions /areas to observe/analyze
Comfort and Image	Safe, Walk-able, Sit-able, Attractive & Historic	1. Does the place make a good first impression?
		2. Are there as many women as men?
		3. Are there enough places to sit? Are seats conveniently located? Do people have a choice of places to sit, either in the sun or shade?
		4. Are spaces clean and free of litter? Who is responsible for maintenance?
		5. Does the area feel safe? Are there security personnel present? If so, what do these people do? When are they on duty?
		6. Are people taking pictures? Are there many photo opportunities available?
		7. Do vehicles dominate pedestrian use of the space or prevent them from quickly getting to space
Access and linkages	Accessible, Convenient, Walk-able, Connected & Proximity	1. Can one see the public open spaces from a distance?
		2. Is there a good link between the public open space and adjacent urban design elements? Or, are they surrounded by elements that discourage people from entering?
		3. Do the neighbors occupying the adjacent buildings use the public open space?
		4. Can people easily walk there? Or are they intimidated by heavy traffic, for example?
		5. Are there sidewalks? Do they lead to and from adjacent areas?
		6. Are there paths throughout the public open spaces? Are they convenient in taking people where they want to go?
		7. Is there a variety of transportation options to and from the public open spaces?

Source: Adapted from UN-Habitat (2016), NCG (2014), and PPS (2012).

Appropriateness of public open spaces in hot semi-arid climates is vital. The study applies the basic steps in the environmental design approach to collect climatic factors, analyze collected information, and develop appropriate design measures. Table 3.3 breaks down qualitative data on climate, and table 3.4 describes selected sustainable features of public open space.

Table 3.3: Appropriateness of public open spaces with climatic factors

Climatic factors in public space design		Indicators	Appropriateness questions/ what to observe or check
1. Solar radiation	Direct radiation: Light Heat Energy-photosynthetic	Time of the day	What time of the day are the public open spaces full or most active?
		Water features	Are there water features? Do they have a cooling effect on open spaces
		Shaded areas	Are the spaces shaded? What shades the spaces?
		Vegetation cover	Are there lawns, ground covers, trees, and shrubs?
	Reflected light-glare Reflected heat-thermal Reflected energy-	Surface texture	Is the floor surface rough or smooth? Is made of what?
		Surface color	Is the floor surface bright or dull?
		Hard surfaces	Are there paved surfaces? What is their area coverage?
		Soft surfaces	Are there landscaped surfaces? What is their area coverage?
		Type of plants	Are plant species indigenous or exotic?
2. Temperature	Air temperature	Vegetation cover	Refer to number 1 above
		Water features	
	Surface temperature	Soft surfaces	
		Hard surfaces	
3. Wind and Air movement	Wind speed	Windbreaks:	Are there windbreaks in public open spaces of Isiolo?
	Wind direction	Orientation:	How are spaces oriented concerning wind direction?

Source: Adapted from Hooper (1974), Gut & Ackerknecht (1993) and UN-Habitat (2014).

Climatic factors in public space design		Indicators	Appropriateness questions/ what to observe or check
4. Relative humidity	Vegetation	Vegetation cover:	Observations are similar to those in temperature, and solar radiation observed earlier.
	Water bodies	Water features:	
5. Precipitation	Rainfall, sleet and Hail	Infiltration:	Similar to sustainable design indicators in table 3.4
		Drainage:	
		Storm water:	
		Other water sources:	
6. Micro climate	Topography	Physical features:	Is there a physical feature nearby the spaces?
	Groundcover	Type of surface:	Observations are similar to those in temperature, and solar radiation observed earlier.
	Water	Waterbody:	Observations are similar to those in temperature observed earlier.
	Building fabric & densities	Layout:	Do adjacent buildings cast shadows on the public open spaces?

Source: Adapted from Hooper (1974), Gut & Ackerknecht (1993) and UN-Habitat (2014).

Table 3.4: Sustainable design indicators in public open spaces

Sustainable design indicators	Key questions / what to observe
Climate responsive design	Does the design encourage using available resources like shading with local tall trees to provide comfortable public open spaces?
Integrated design	Does the design factor in energy issues like efficiency? Use of solar power or wind power?

Outdoor climate mitigation	Does the design improve comfort by using shading and water to cool surfaces?
Water conservation	Does the design encourage an efficient water management system, like recycling?
Sustainable drainage	Does the design encourage on-site infiltration systems and putting accumulated water into use? Like the use of swales?
Green infrastructure	Does the design encourage the restoration of natural water balance like the use of stormwater?
Xeriscaping	Does the design encourage the use of appropriate plants and soil in landscaping?
Vernacular	Is the design inspired by local culture in terms of layout, site selection, and uses of indigenous plants?

Source: Adapted from UN-Habitat (2014); EPA (2009); Valarie (2014); UNEP (1999) and Emmanuel (2011).

3.2.2 Population frame

Rukwaro R (2016) defines a population as a group of events, objects, and individuals. The study maps out all public open spaces in Isiolo municipality and purposively identifies the Urban Park as the unit of analysis. See maps 4.2 and 4.3

3.2.3 Sampling size

The sample size is the number of units, subjects, objects, or items in a sample drawn from a population (Mugenda & Mugenda, 2012). For a descriptive study, a sample of 10% of the accessible population or at least 30 respondents is enough. However, a researcher is encouraged to take a more significant sample as possible as time and resources would allow (Mugenda & Mugenda, 1999). In the case of Isiolo municipality, the sample size identified is representative of experts in urban design and development, urban management, public open spaces users, residents, political leaders, and opinion leaders

3.2.4 Sampling techniques

Sampling techniques refer to the process of selecting a suitable representative part of a population for determining the characteristics of the whole proportion (Mugenda & Mugenda, 2012). In identifying Isiolo municipality, the Urban Park, and respondents, the study applies purposive sampling.

Purposive sampling allows a researcher to use cases with the required objectives and determine where the observation units have the required characteristics (Mugenda & Mugenda, 1999).

3.3 Data sources, collection and recording tools

The study applies a survey of the study area, observations, experts, and institutions to obtain primary data.

The study collects secondary data from books, journals, reports, government sources, online, and previously published and unpublished theses. The study is descriptive and applies observation checklists, questionnaires, interview schedules, and focused group discussions as data collection tools.

Questionnaires used are both open-ended and close-ended, while interview schedules are semi-structured.

The author uses photos, sketches, notes, a camera, pencil, pen, paper, clipboard, and notebook as data recording tools in recording data.

3.4 Data analysis and presentation

Data collected are subjected to evaluation to ensure accuracy and completeness and fill all gaps. Data was collected, edited, and classified based on common characteristics to ease analysis. Data collected was cross-checked based on the observation made vis-à-vis the response from the respondents.

The qualitative data are presented in photos, sketches, and maps, while graphs, pie charts, and tables represent quantitative data.

The data is analyzed, and the findings discussed in chapter 4

3.5 Data validity and reliability

The author analyses data collected through observation and data collected through interviews and questionnaires to test its validity and reliability as far as the study is concerned.

3.6 Conclusion

Isiolo municipality is an appropriate study area due to its strategic location, the epicenter for Kenya's vision 2030, and climate. Therefore, the Urban Park is an appropriate unit of analysis in studying public open spaces in Isiolo municipality. Guided by study objectives, units of analysis, and probable questions set.

Data handling from the collection, recording, and analysis to presentation is in this chapter.

Figure 3.3 on page 47 is a conceptual framework of the study

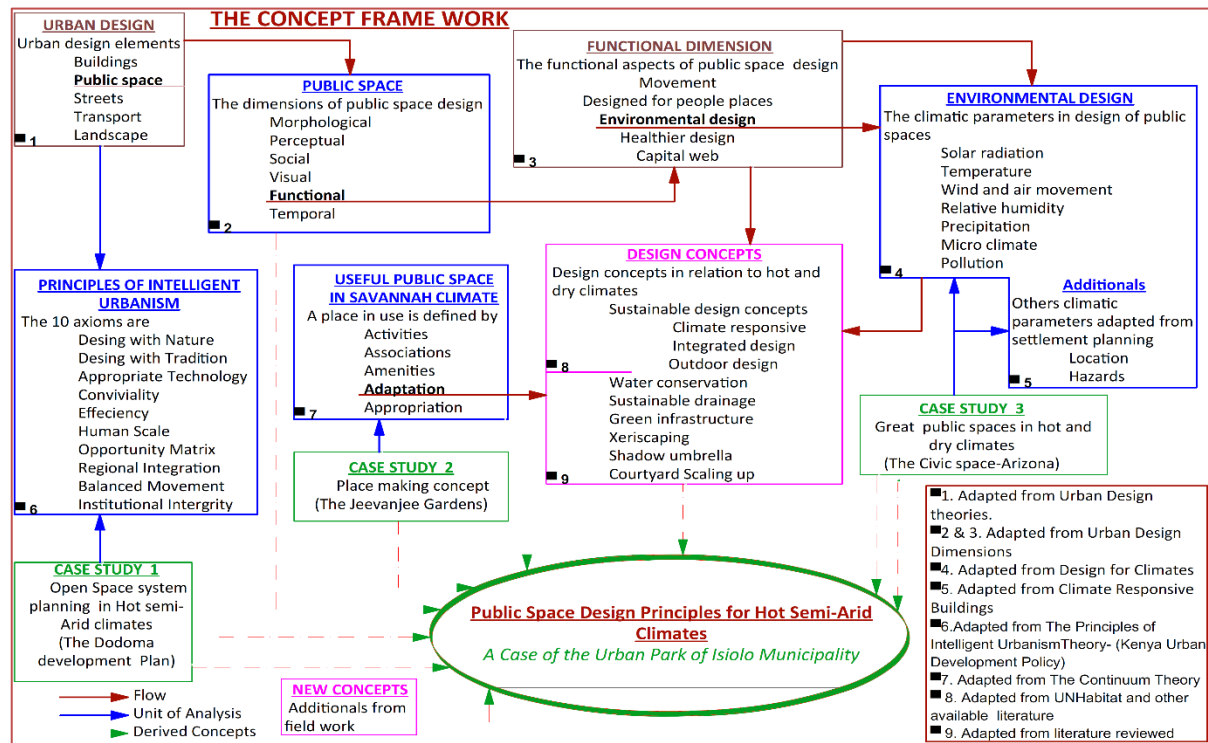


Figure 3.3: Conceptual framework.
Source: Author, 2018.

CHAPTER IV- ISIOLO'S URBAN PARK

4.0 Background of Isiolo municipality

Located at 0021'10.72" N and 37035'9.50" E Isiolo municipality is about 285km north of Kenya's capital: Nairobi. Isiolo municipality is on a transit corridor A2 road linking Nairobi to Addis- Ababa in Ethiopia and covers an area of about 65km² (Isiolo CIDP, 2018-2022). Isiolo municipality started as a military base. A strategic gateway to the North of Kenya in 1928, Isiolo municipality was designated as district headquarters for the Northern Frontier Districts (Isiolo CIDP, 2018-2022).

Isiolo municipality is now a dominant urban center in Isiolo County, the principal commercial and administrative capital. Therefore, Isiolo municipality is currently a municipality as per the Urban Areas and Cities (Amendment) Act of 2019.

The Ewaso Ngiro North River, located north of the town, serves Isiolo municipality. The primary land tenure system in Isiolo municipality is leasehold: individual allotments (Isiolo CIDP, 2018-2022).

Isiolo municipality is a significant part of Kenya's economic development plan: The Kenya Vision 2030. It is the epicenter of the vision's flagship projects: the LAPSSET corridor, the Isiolo international airport, the Isiolo resort city, and Isiolo oil storage facilities (Isiolo CIDP 2018-2022).

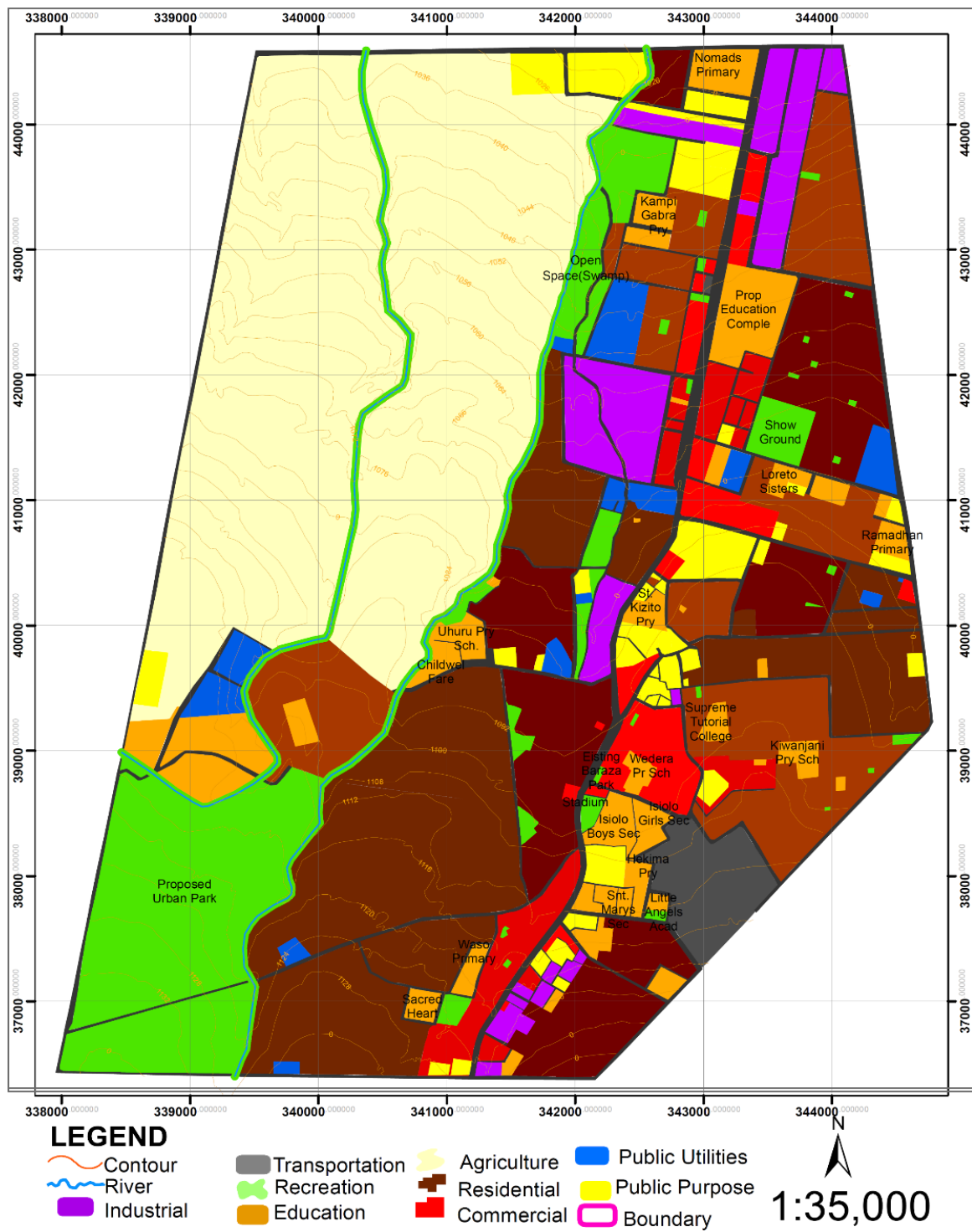


Figure 4.0: Isiolo's Land use plan
 Source: Author, 2018

In 2009, Isiolo municipality had 46,578 people (KNBS, 2009), estimated to be about 80,000 according to KNBS (2012) projections. The population will increase when planned Kenya vision 2030 flagship projects are actualized (Isiolo CIDP, 2018-2022). Figure 4.1 shows the urban population of Isiolo municipality in terms of age groups and sex in 2009, and the same project to 2030.

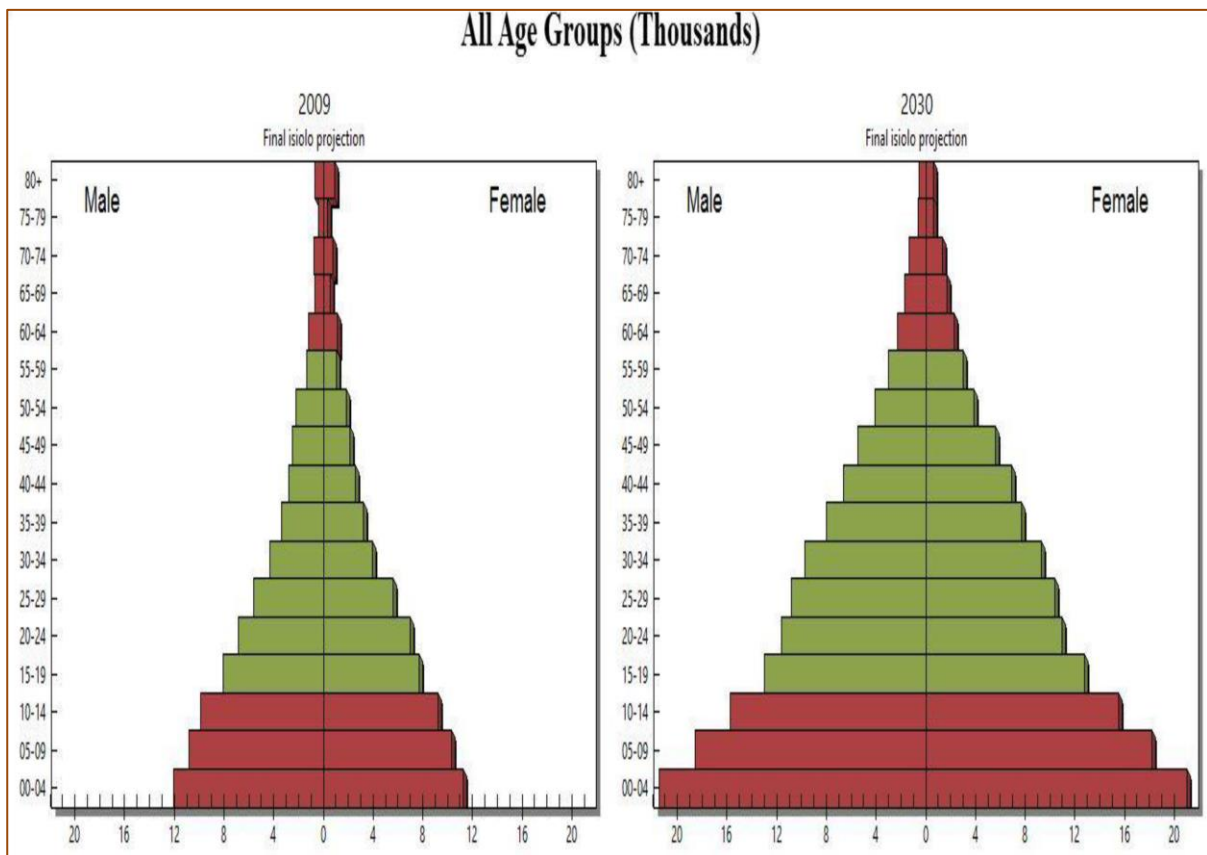


Figure 4.1: pyramid showing Isiolo municipality population and projections
Source: Adapted from spectrum (2017)

4.1 Mapping and documentation of public open spaces at Isiolo municipality

Isiolo municipality has the highest urban population in the county, as shown by the graph in figure 4.2. The urban population will grow up to 34% by 2017.

The high urban population will put more pressure on undeveloped public open spaces in Isiolo municipality. Population distribution is even across gender

The development plan of Isiolo municipality has eight land uses whereby public open spaces are part of recreational land use.

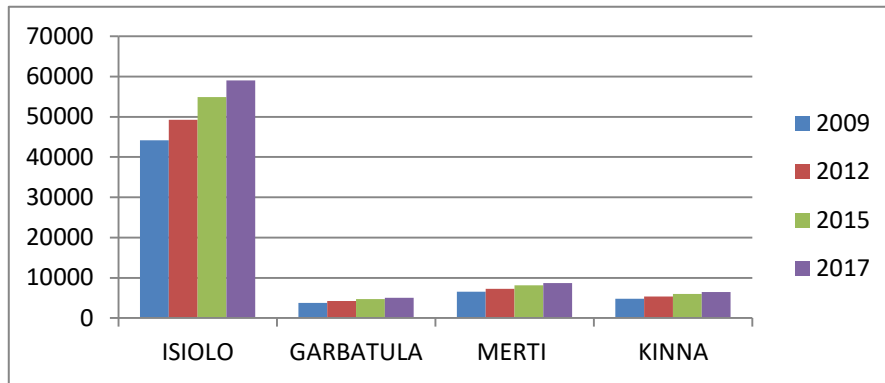


Figure 4.2: Urban population projection in Isiolo County.
Source: Adapted from Isiolo CIDP (2013)

The pie chart in figure 4.3 shows land use in Isiolo municipality. Public open spaces are 6% land use against the recommended 13.2 % physical planning (2002).

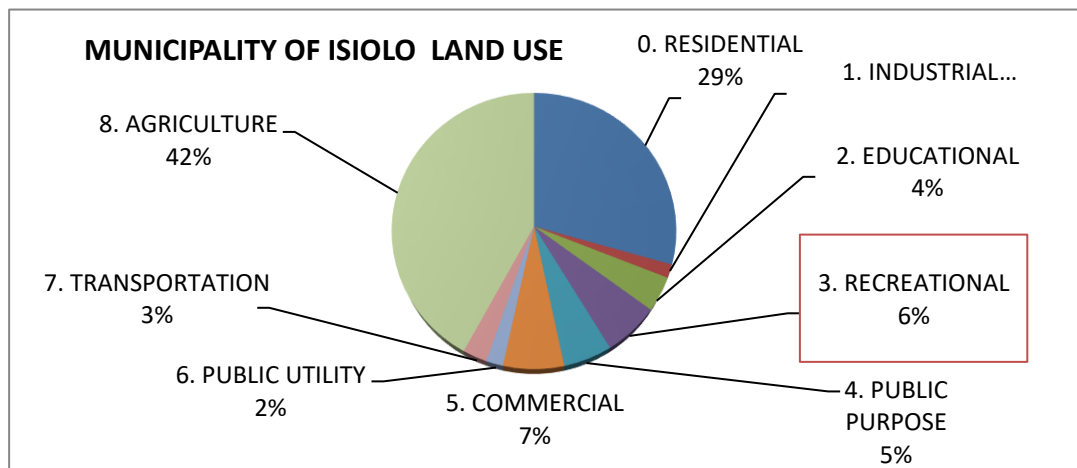


Figure 4.3: Pie chart showing land use in Isiolo municipality.
Source: Adapted from Isiolo municipality development plan (2007)

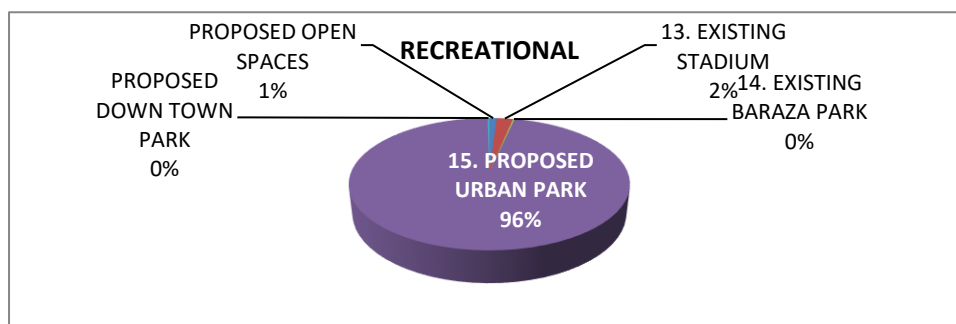
Table 4.1 shows the recreational land uses and corresponding sizes in hectares, while the pie chart in figure 4.4 shows their percentages.

Public open spaces in Isiolo municipality are parks and open spaces as per the development plan. Existing public open spaces accounted for less than 1%, and proposed public open spaces account for 97%. Thus, there is room for the design and development of public open spaces in Isiolo municipality. See the map in figure 4.5

Table 4.1: Recreational land uses at Isiolo municipality

LAND USE PROPOSAL		
ZONE	USER	AREA (Ha)
3 RECREATIONAL		
9	PROPOSED OPEN SPACE	0.2
10	PROPOSED OPEN SPACE	0.3
11	PROPOSED OPEN SPACE	0.2
12	PROPOSED OPEN SPACE	0.2
13	EXISTING STADIUM	3.7
14	EXISTING BARAZA PARK	0.4
15	PROPOSED URBAN PARK	160.0
16	PROPOSED DOWN PARK	0.4
18	PROPOSED OPEN SPACE	0.5
24	PROPOSED OPEN SPACE	0.3
25	EXISTING OPEN SPACE	0.4
TOTAL AREA –OPEN SPACES AND PARKS		162.9
TOTAL URBAN AREA		2680.36
PERCENTAGE OF PUBLIC OPEN SPACES IN ISIOLO MUNICIPALITY		6%

*Table 4.1: Recreational land use and size in hectares
Source: Adapted from Isiolo municipality development plan (2007)*



**Figure 4.4: Pie chart showing public open spaces typologies in Isiolo municipality,
Source: Adapted from Isiolo municipality development plan (2007)**

Existing public open spaces accounted for less than 1%, and proposed public open spaces account for 97%. Thus, there is room for the design and development of public open spaces in Isiolo municipality. See the map in figure 4.5

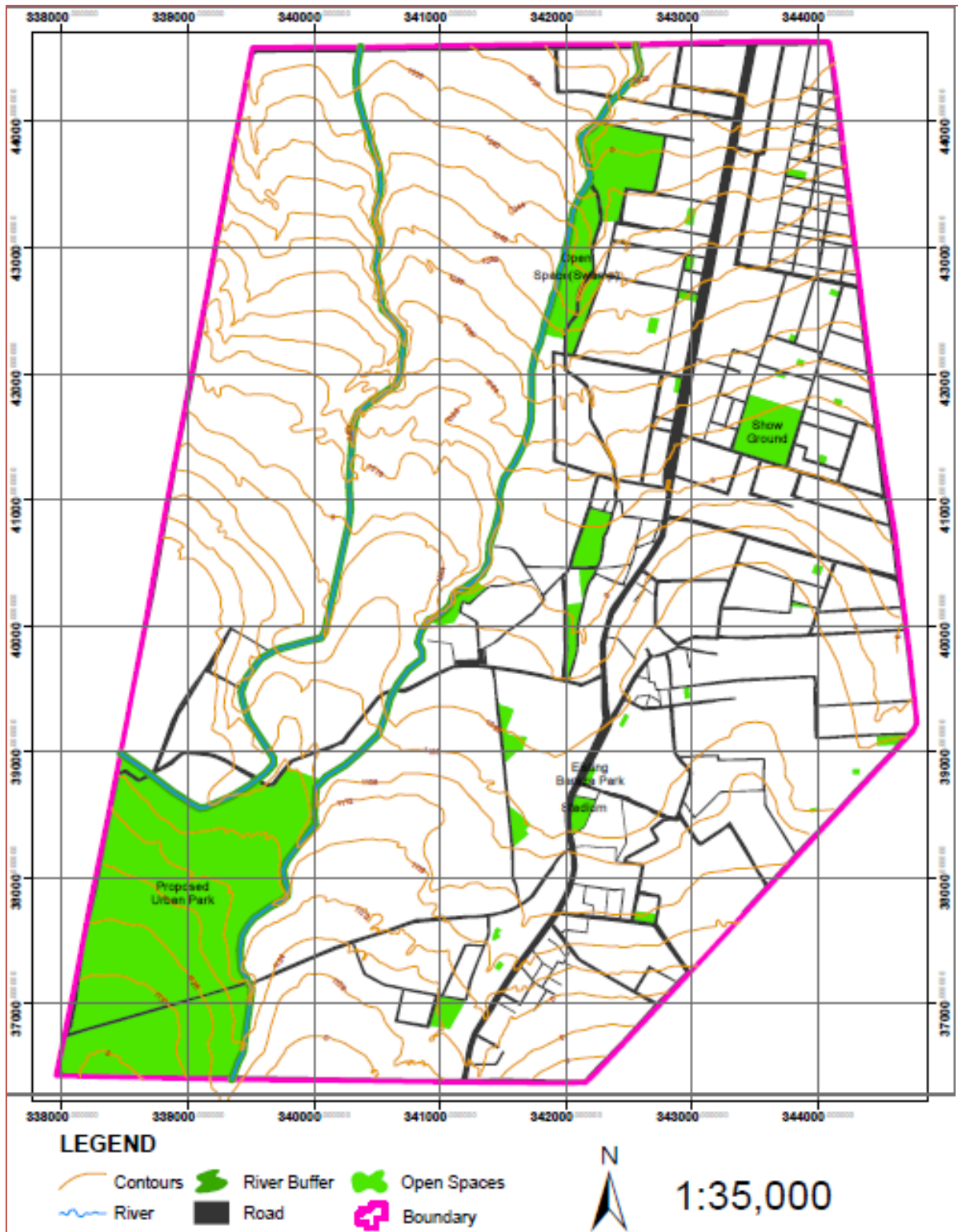


Figure 4.5: Map of Isiolo's public open space
 Source: Author, 2018

The two categories of public open spaces are either existing as of 2007 or proposed. The following figures discuss the observations made for all public open spaces at Isiolo municipality

Figure 4.6 has a google image of existing public open spaces-3.²⁵, the same as the development map and fieldwork image. Public open space is now a residential house. The observation shows the vulnerability of undeveloped public space The development of public open spaces can be a starting point for protecting them; however, in hot semi-arid; climate should inform the design for sustainability purpose.

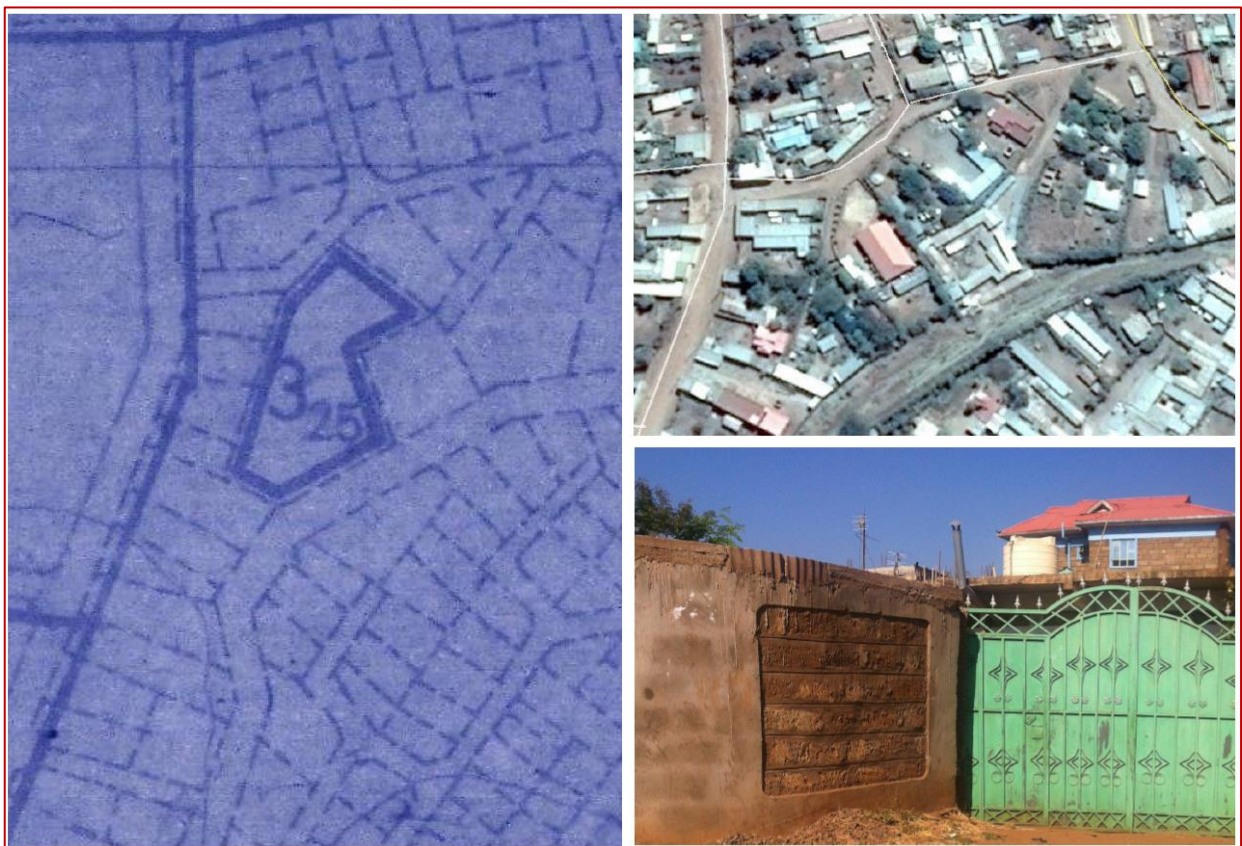


Figure 4.6: Existing public open spaces-3.25

Source: Adapted from Isiolo municipality development plan (2007), Google earth (2018) and field work survey (2018)

Figure 4.7 has a google image of a public open spaces-3¹⁴, its location on the development plan, and a field survey image. The author observed that the designed Park is open to the public. However, its use deteriorated, leading to its use as a storage center and its partial closure. The traders occupied the Park and developed informal structures.



Figure 4.7: Existing Park 3.14

Source: Adapted from Isiolo municipality development plan (2007); Google earth (2018) and field work survey (2018)

Figure 4.8 is an image of Baraza Park in July 2018, and Figure 4.9 is an image of Baraza Park in August 2018.

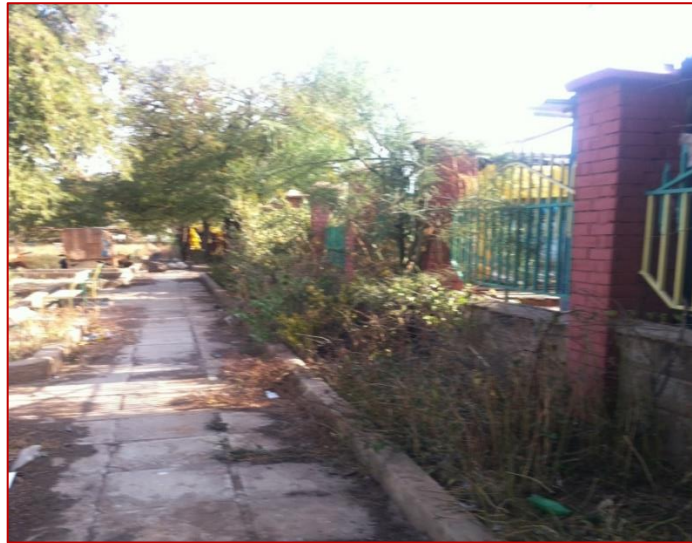


Figure 4.8: Baraza Park 3.14 in July 2018
Source: Author, 2018



Figure 4.9: Baraza Park 3.14 in August 2018
Source: Author, 2018

Baraza Park is now a make-shift market. Public open spaces in the hot semi-arid need to design with climate in mind to bring out their value. An attempt to design the Park did not bring out its value or its usefulness hence the decay.

Figure 4.10 has a part of the Isiolo municipality development plan (2007), a google map image (2018), and images taken during a field survey (2018); for the proposed Down Park-3¹⁶.

The down park proposed about 0.4ha per the Isiolo municipality development plan (2007). However, the allocated area is now a commercial building and a petro station.

Failure to develop the public open spaces exposes them to other competing land uses that are encouraged by the strategic location of the public open spaces and the lack of its usefulness to urban residents.



Figure 4.10: proposed Down Town Park

Source: Adapted from Isiolo municipality development plan (2007), Google earth (2018) and field work survey (2018)

Figure 4.11 has a part of the development plan, google images, and images were taken during the field survey; for the proposed open space-3²⁴

The proposed open space is not developed and therefore endangered space. The open space is in a middle of a residential area

Therefore, in Isiolo municipality, public open spaces are endangered by commercial land use, residential land use, and agricultural land use.



Figure 4.11: Proposed open space

Source: Adapted from Isiolo municipality development plan (2007), Google earth (2018) and field work survey (2018)

Figure 4.12 has a part of the development plan, google images, and images were taken during the field survey; for the proposed Urban Park - 3¹⁵

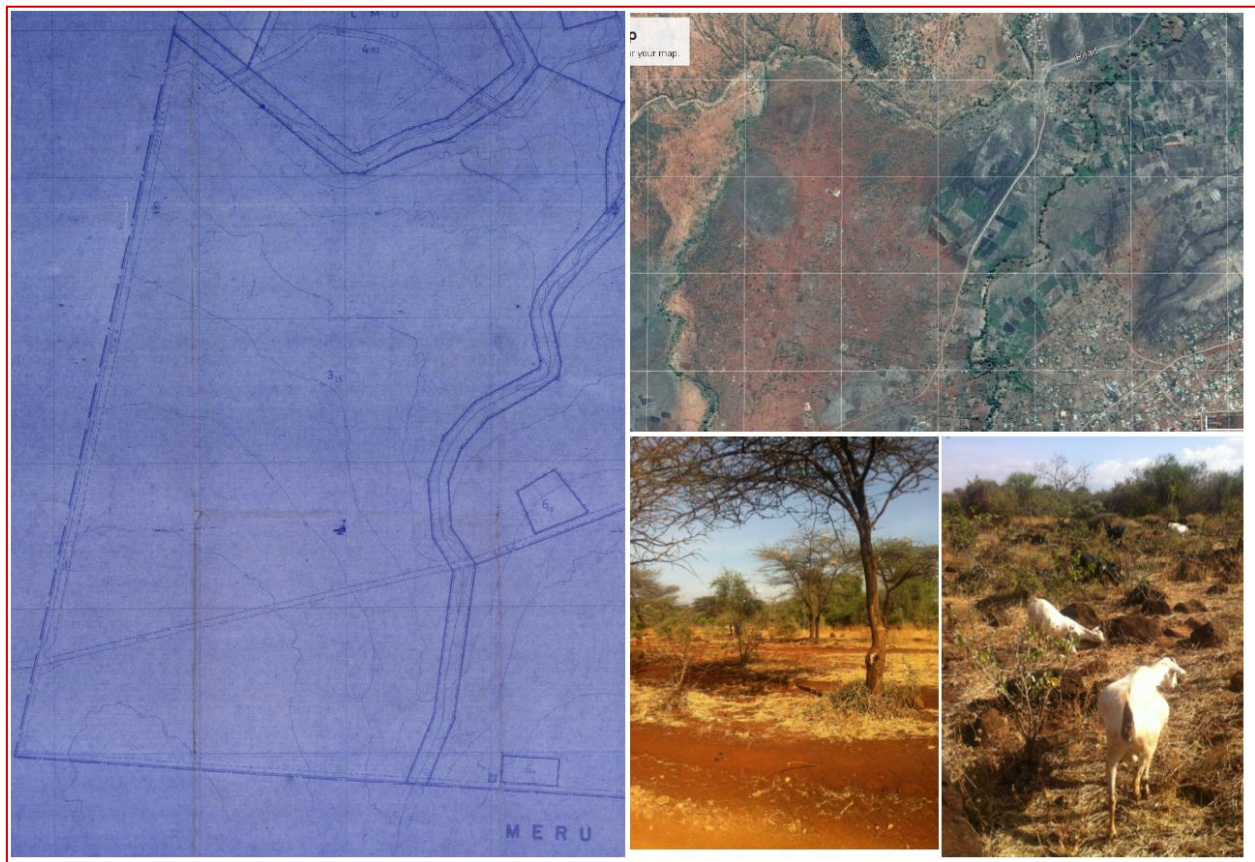


Figure 4.12: proposed urban Park

Source: Adapted from Isiolo municipality development plan (2007), Google earth (2018) and field work survey (2018)

4.1.1 The urban Park

The proposed Urban Park is 160ha and 97% of public open spaces in Isiolo municipality. However, it has not been developed and faces the familiar challenge of encroachment by residential land use and agriculture.

Figure 4.12 indicates some of the activities at the proposed Urban Park.

Undeveloped public open spaces are vulnerable public open spaces; however, they can provide a guide on indigenous plants, local culture, and how the community utilizes public open spaces

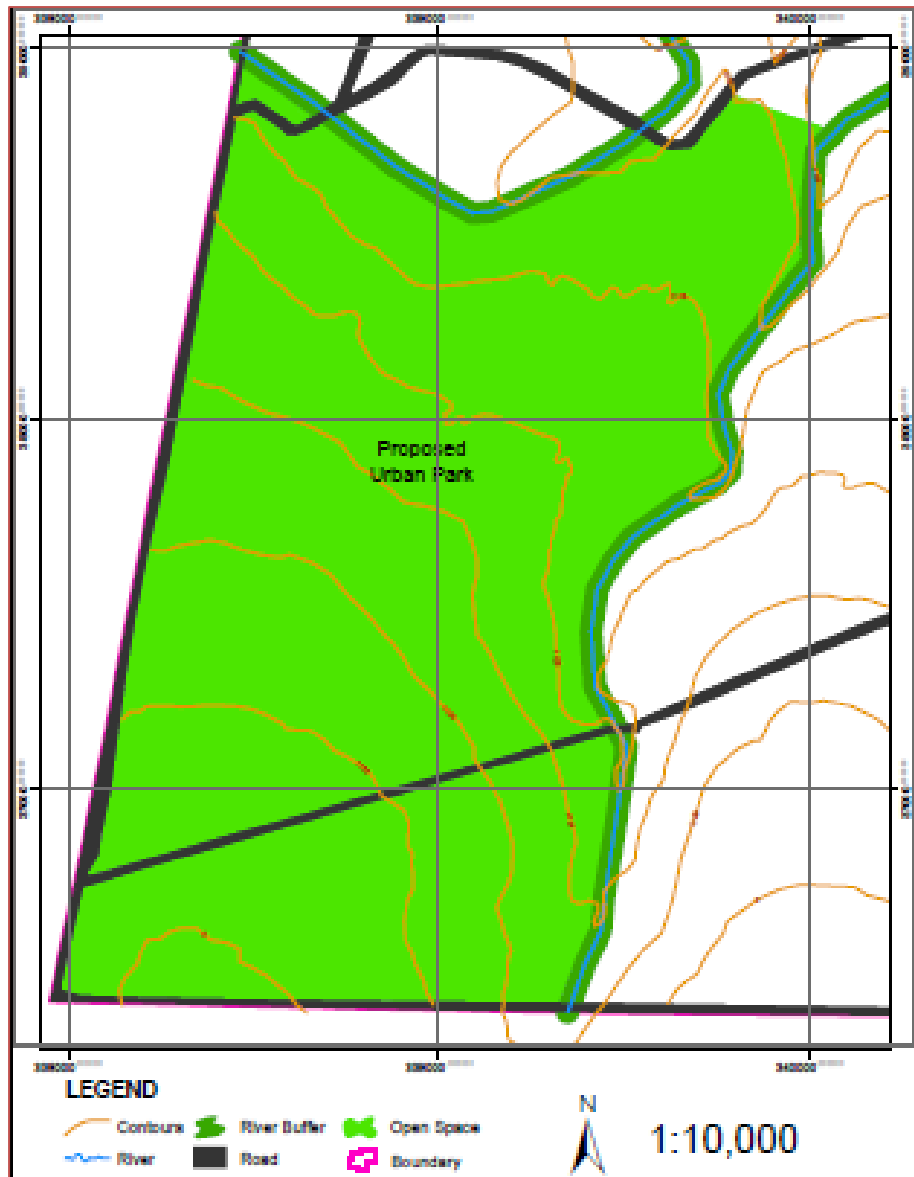


Figure 4.13: Map of the proposed Urban Park
Source: Author, 2018

4.1.2 Analysis of public open spaces at Isiolo municipality

The public open spaces indicators are; the supply of public open spaces; the quality of public open spaces, and distribution of public open spaces. The following are findings and brief discussions of the status of public open spaces in Isiolo municipality in terms of supply, quality, and distribution

The supply of public open spaces is as follows; the surface area of public open spaces over the total urban population. For example, the total surface area of public open spaces in Isiolo

municipality is 166.6Ha, diminishing due to encroachment where else the population is increasing.

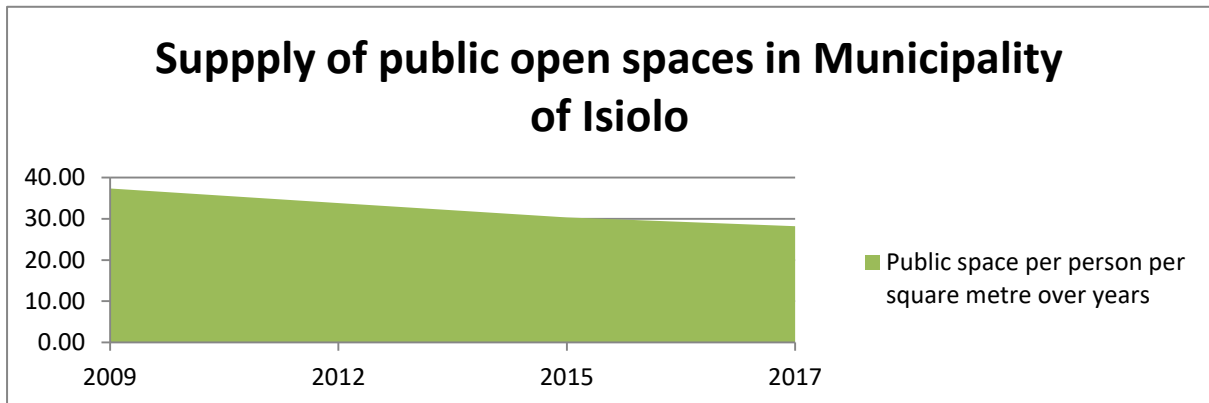


Figure 4.14: Graph showing supply of public open spaces in Isiolo municipality over time
 Source: Adapted from Isiolo CIDP (2013) and UN-Habitat (2015)

As of 2017, the supply of public open spaces in Isiolo municipality is 28.m² per person. However, due to encroachment which is about 30%, the supply is about 19.6m² per person. Therefore, if public open spaces were at 13.2% as recommended in physical planning (2012); and developed as they should be, the supply of public open spaces in Isiolo municipality would be 62m² per person in 2017. The graph in figure 4.14 shows the decline of public open spaces in Isiolo municipality per person due to population growth. The quality of public open spaces is as good as the maintenance budget per inhabitant. With a projected population of 59,047 in 2017, Isiolo municipality has a budget of 170,000 as per Isiolo municipality finance and planning (2017). The quality stands at 2.8 Kenya shilling per inhabitant. The existing public supply of 19.6m² translates to 0.14 Kshs per square meter per year.

The budget allocated for maintenance is low, explaining why the public open spaces are neglected and of poor quality.

The distribution of public open spaces considers the supply and spread of public open spaces in an urban quadrant.

96% of public open spaces is a proposed gigantic park; therefore, most of Isiolo's municipality population is far from 200-300m from the public open spaces. Other public open spaces are near Isiolo municipality CBD, estimated to account for 15% of the entire population. Therefore, 85% of the population is farther away from public open spaces in Isiolo municipality, with more than 40,000 inhabitants.

The development plan focuses on the surface area of public open spaces, ignoring the distribution. For example, in Isiolo municipality, 96% is a single public open space and more than 10km from one end, as shown in the public open space map in figure 4.5.

4.1.3 The Urban Park

The Urban Park is located on the south-western side of Isiolo municipality and covers 160 Ha in size, making it the most significant public space in Isiolo municipality.

The Park is undeveloped and under pressure from other land uses. Nevertheless, this is an ideal public space that needs urgent urban design intervention, and therefore, the study narrows to the urban Park and subjects it to further analysis.

4.2 Utilization of the Urban Park at Isiolo municipality

The illustration of Urban Park's appropriateness is after a comparative analysis guided by theories and case studies. These theories are principles of urbanism best seen in Dodoma's open space system, the place-shaping continuum theory, and the place-making concept. UN-Habitat is spearheading the place-making concept with technical inputs from Gehl Architects. Place making is the concept demonstrated at Jeevanjee in Kenya. The sustainable concept considers public open spaces that are useful in hot and semi-arid areas. A great example is a civic space in Arizona, identified as a case study. The following are the findings on the appropriateness of the urban Park.

Table 4.2: Use and activities at Urban Park

Indicators	Key Questions	Observations made
Active spaces, Fun full, Vital, Special & Real	1.Are people using the Urban Park, or is it empty?	(Yes) The Urban Park is in use
	2.Do people of different ages use it?	(Yes). Different ages use Urban Park
	3.How many different types of activities are occurring at one time? (For example, people walking, eating, playing, relaxing, or reading?)	Eight types of activities occur at Urban Park; namely relaxing, waiting for the area, group discussions, meetings, playing, grazing, and preaching
	4.Identify parts of the Urban Park that are used and not in use?	Shaded areas are primarily in use, unlike un-shaded areas
	5.Is there a presence of management? Or can one identify anyone in charge of the Urban Park?	None

Source: Author, 2018

Activities at Urban Park are; relaxing, waiting area, group discussions, meetings, playing, grazing and preaching.

The most common activity at Urban Park is meetings followed by relaxation and then playing.

Respondent's views on measures put in place to draw in users in Urban Park are as follows; 18% highly inadequate; 33% inadequate; 43% fairly adequate; 2% adequate, and 4% highly adequate, as shown in figure 4.15.

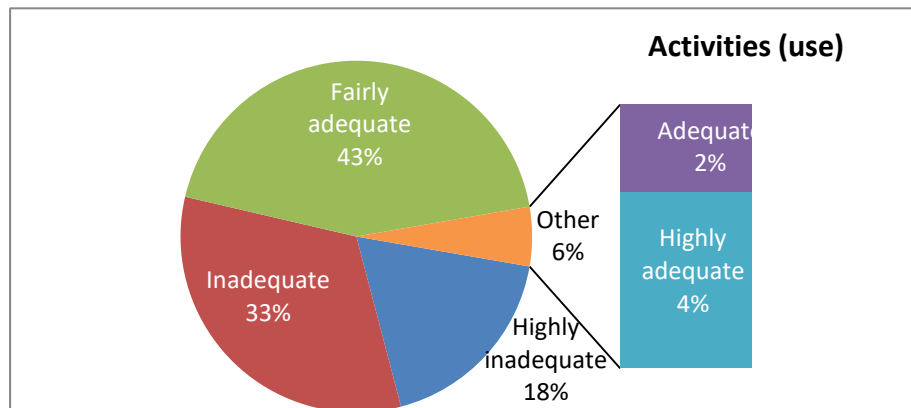


Figure 4.15: Pie Chart showing activities set to draw in users to the Urban Park
Source: Author, 2018

Table 4.3: Sociability at the Urban Park

Indicators	Key Questions	Observations
Diverse, Stewardship, Cooperative, Neighborly & Welcoming	1. Is this a place where one would choose to meet a friend? Are others meeting friends here?	No Yes
	2. Do people form groups? Are they talking to one another or other groups?	Yes
	3. Do people seem to know each other by face or by name?	Yes
	4. Do people bring their friends and relatives to see the place? Do they point to its features with pride?	No
	5. Are people smiling? Do people make regular eye contact with each other?	No
	6. Do many people use the place frequently	No
	7. Does the mix of ages and ethnic groups generally reflect the community at large?	Yes
	8. Do people tend to pick up litter when they see it?	No

Source: Author, 2018

How people relate at Urban Park is described as; friendly. Respondents' views on measures put in place to allow users to differentiate themselves in Urban Park naturally and recorded as follows; 7% highly inadequate; 15% inadequate; 51% fairly adequate; 18% adequate, and 9% highly adequate and shown in figure 4.16

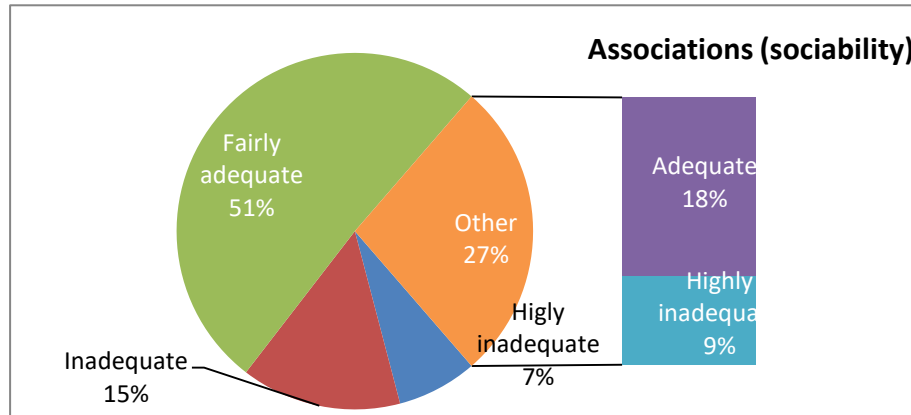


Figure 4.16: Pie chart showing associations' enhancement measures at Urban Park
Source: Author, 2018

Table 4.4: Comfort and Image at the Urban Park

Indicators	Essential Questions /areas to observe/analyze	Observations
Safe, Walk-able, Sit-able, Attractive & Historic	1. Does the Urban Park as a place make a good first impression?	No
	2. Are there as many women as men?	No
	3. Are there enough places to sit? Are seats conveniently located? Do people have a choice of places to sit, either in the sun or shade?	No
	4. Are spaces within the Urban Park clean and free of litter? Who is responsible for maintenance?	No; No one
	5. Does the area (Urban Park) feel safe? Are there security personnel present? If so, what do these people do? When are they on duty?	No
	6. Are people taking pictures? Are there many photo opportunities available?	No
	7. Do vehicles dominate pedestrian use of the space or prevent them from quickly getting to space	No

Source: Author, 2018

Amenities play a vital role in public open spaces as they dictate the use and attract users. Respondents' views on their adequacy at Urban Park and recorded as follows; 15% highly inadequate; 25% inadequate; 51% fairly adequate; 7% adequate, and 2% highly adequate and shown in figure 4.17

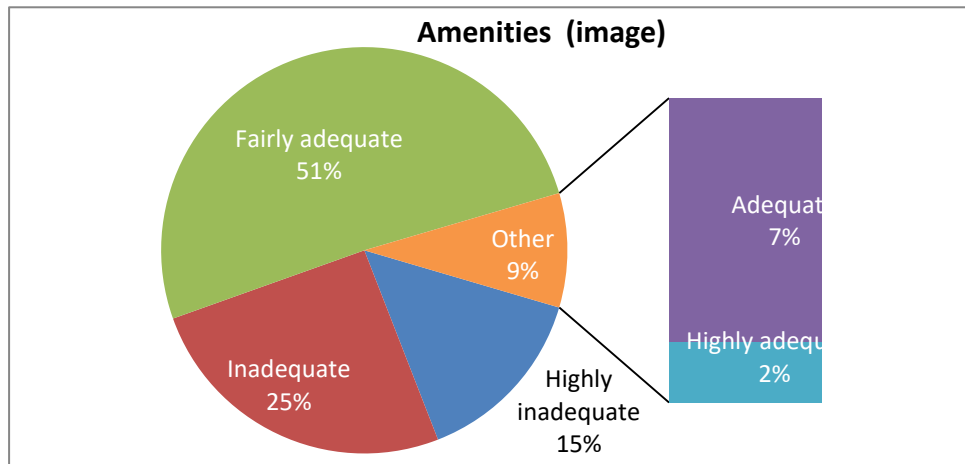


Figure 4.17: Pie chart showing adequacy of Amenities at Urban Park
Source: Author, 2018

Adaptation of public open spaces is vital in hot semi-arid climates and also in a changing environment. Respondents' views on measures taken to enhance the Urban Park's resilience are as follows; 11% highly inadequate; 22% inadequate; 40% fairly adequate; 25% adequate, and 2% highly adequate, as shown in figure 4.18.

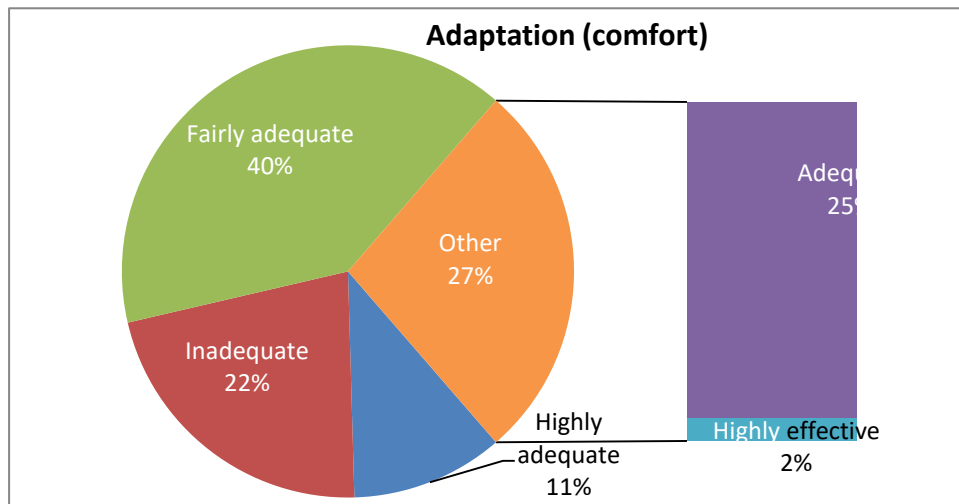


Figure 4.18: Pie chart showing Adaptation; resilience enhancement measures for the Urban Park
Source: Author, 2018

Table 4.5: Access and linkages at the Urban Park

Indicators	Essential Questions /areas to observe/analyze	Observations
Accessible, Convenient, Walkable, Connected & Proximity	1. Can one see the Urban Park from a distance?	Yes
	2. Is there a good link between the Urban Park and the adjacent urban design elements? Or, are they surrounded by elements that discourage people from entering?	No No
	3. Do the neighbors occupying the adjacent buildings use the Urban Park?	Yes
	4. Can people easily walk there? Or are they intimidated by heavy traffic, for example?	Yes, No
	5. Are there sidewalks? Do they lead to and from adjacent areas?	Yes
	6. Are there paths throughout the Urban Park?	Yes
	7. Are they convenient in taking people where they want to go?	No
	8. Is there a variety of transportation options to and from the public open spaces?	No

Source: Author, 2018

The use of public open spaces is different in purposes from the initial envisage use. Consequently, the respondents' views on measures taken in recognition of the real future potential of the Urban Park are; 33% highly inadequate, 45% inadequate; 20% fairly adequate; 2% adequate, and 0% highly adequate, as shown in the pie chart in figure 4.19.

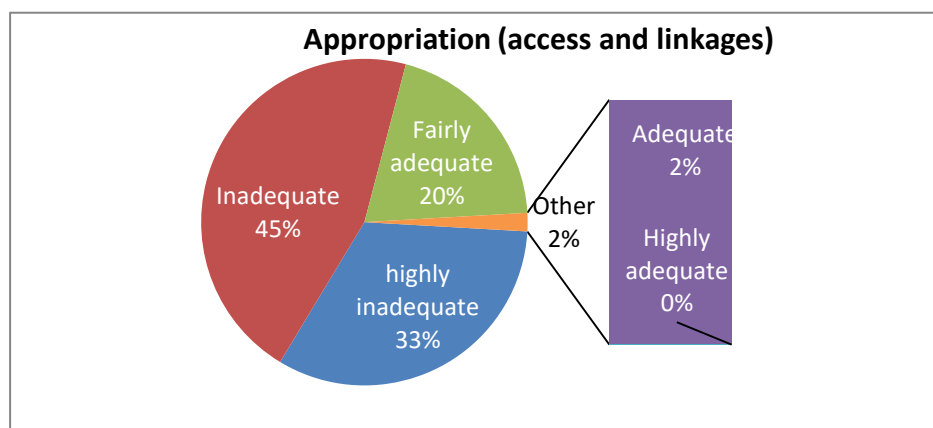


Figure 4.19: Pie chart showing Appropriation measures for the urban park
Source: Author, 2018

Table 4.6: Summary of the usefulness of the Urban Park as observed

N ^o	Continuum theory -5As	Average Ratings	Ratings					
			1	2	3	4	5	
1.	Activities/ use	2.4		2				
2.	Associations/ sociability	3.0			3			
3.	Amenities/ and image	2.6		2				
4.	Adaptation/ comfort	2.9		2				
5.	Appropriation/ access and linkages	1.9	1					
Summary ratings								

Author, 2018

Measures taken to enhance the usefulness of the Urban Park at Isiolo municipality are inadequate, as summarized in Table 4.6

4.2.1.1 The environmental design analysis of the Urban Park

The functional dimension of public open spaces design entails the functional aspects: movement, design for people places, environmental design, healthier design, and capital web, as explained by Carmona et al. (2010). The study captures the environmental design by using the climatic parameters in design as the core units of analysis: solar radiation, temperature, wind, air movement, relative humidity, precipitation, microclimate, pollution, location, and hazards. Hooper (1975) and Isiolo CIDP (2018-2022) provide the quantitative climatic data, while the qualitative data is derived and established by reviewing; Hooper (1975); Gut, P. & Ackerknecht, D. (1993), and UN-Habitat (2014). Table 4.7 is a summary of climatic data of Isiolo municipality.

Table 4.7: Isiolo municipality's climatic data

Climatic parameters	Data for Isiolo municipality	Data sources
1. SOLAR RADIATION	9 hours of sunshine per day	Isiolo municipality CIDP (2018-2022)
2. TEMPERATURE	Low by night in May to October	Hooper (1975)
	High by day from October to April	
	The annual mean maximum is 27-30°C	
	The annual mean minimum is 15.5-19.5°C	
	The diurnal range is 11-13. 5°C	
3. WINDS	Strong winds throughout the year, peaking in July and August	Isiolo municipality CIDP (2018-2022)
	Strong enough to lift dust off barren land	Hooper (1975)
4. RELATIVE HUMIDITY	The annual mean at 1500Hrs is 43-55%	Hooper (1975)
5. PRECIPITATION	Annual rainfall is 500-1050mm	Isiolo municipality CIDP (2018-2022)
	Short rains in October and November	
	Long rains in March, April, and May	

Source: Adapted from Isiolo municipality CIDP (2018-2022) and Hopper (1975).

Table 4.7 shows the quantitative data on climate. The study also obtained qualitative data; structured on design interventions applied at the Urban Park, as shown in table 4.8 to 4.16.

Table 4.8: Design interventions in response to solar radiation at the Urban Park

CLIMATIC PARAMETERS		OBSERVABLES	DESCRIPTION	RATING S				
				1	2	3	4	5
1. Solar radiation	Direct radiation: Light Heat Energy-photosynthetic	Time of the day Water features Shaded areas Vegetation cover	Isiolo municipality receives 9hrs of sunshine per day. The Urban Park has inadequate vegetation cover due to charcoal burning. The types of shrubs found here have limited shading properties and no water bodies. This observation informs the lower ratings (1) of the urban Park as far as design interventions; that shape solar radiation constraints.	1				
	Reflected light-glare Reflected heat-thermal Reflected energy-	Surface texture Surface color Hard surface Soft surface Type of plants	The surface texture of the Urban Park is generally rough, the color is bright, and there are more soft natural surfaces than hard surfaces (though bare, thus as good as hard surfaces) Shrubs and hardy plants dominate the public open spaces. The reflected radiation is slightly high, and this informs the fair lower (2) ratings far as design interventions put in place to shape the solar radiation constraint are concerned		2			
Design interventions (1- Highly inadequate, 2-Inadequate 3- Fairly adequate, 4-Adequate, 5-Highly adequate)				1				

Source: Author, 2018.

The design interventions applied at an urban park in response to solar radiation are; $(2+1)/2=1.5$; **highly inadequate**, as described in table 4.8 above.

Table 4.9: Design interventions in response to temperature at Urban Park in Isiolo municipality

CLIMATIC PARAMETERS		OBSERVABLES	DESCRIPTION	RATING				
				1	2	3	4	5
2. Temperature	Air temperature	Vegetation cover Water features	The Urban Park has no water features; has scattered trees and shrubs Due to low vegetation, the design interventions to mitigate high temperatures are highly inadequate and rated (1).	1	2	3	4	5
	Surface temperature	Soft surfaces Hard surfaces	Soft surfaces like lawns are essential in reducing surface temperatures; in Urban Park, lawns are a rare phenomenon. Hard surfaces increase surface temperature. At the Urban Park, hard surfaces eclipse the soft surfaces. Design interventions put in place to shape this constraint are inadequate and rated (2).		2			
Design interventions (1- Highly inadequate, 2-Inadequate 3- Fairly adequate, 4-Adequate, 5-Highly adequate)				1				

Source: Author, 2018.

In response to high temperature, design interventions applied at Urban Park are rated as $(1+2)/2=1.5$; **highly inadequate**, as described in table 4.9.

Table 4.10: Design interventions in response to wind and air movement at Urban Park in Isiolo municipality

CLIMATIC PARAMETERS		OBSERVATIONS	DESCRIPTION	RATING					
				1	2	3	4	5	
3. Wind and Air movement	Wind speed	Windbreaks	There are strong winds in Isiolo, and the Urban Park lacks artificial windbreakers. Her natural shrubs have limited capacity, and therefore the Urban Park is vulnerable to strong winds. There was no evidence of mitigation measures, which informs the low rating (1) of interventions to shape the wind constraint.	1					
	Wind direction	Orientation	Wind direction informs the designer on installing windbreakers and shielding the public open spaces from solid winds. Wind direction was not a factor in identifying areas suitable for the Urban Park based on the available land surface. Having no interventions made and being a natural landscape, it was rated (2) inadequate		2				
	Ventilation	Soil ventilation	Paved surfaces have negative impacts on soil ventilation. However, the Urban Park has excellent soil ventilation as the walkways and paths are unpaved. Therefore, the current state is pretty adequate and rated (3).			3			
Design interventions (1- Highly inadequate, 2-Inadequate 3-Fairly adequate, 4-Adequate, 5-Highly adequate)				2					

Source: Author, 2018.

Design interventions applied at the Urban Park in response to wind and air movements are rated as $(1+2+3)/3=2$: **inadequate**, as described in table 4.10

Table 4.11: Design interventions in response to relative humidity at Urban Park in Isiolo municipality

CLIMATIC PARAMETERS		OBSERVABLES	DESCRIPTION	RATING S					
				1	2	3	4	5	
4.	Vegetation Water bodies	Vegetation cover Water features	The Urban Park has no water features and consists of scattered trees and shrubs. The interventions made to improve vegetation cover and bring in water features are highly inadequate and thus rated (1)	1					
Design interventions (1-Highly inadequate, 2-Inadequate 3- Fairly adequate, 4-Adequate, 5-Highly adequate)				1					

Source: Author, 2018.

Design interventions in response to relative humidity at the urban Park are; (1)/1=1; **highly inadequate**, as described in table 4.11.

Table 4.12: Design interventions in response to precipitation at Urban Park in Isiolo municipality

CLIMATIC PARAMETERS		OBSERVABLES	DESCRIPTION	RATING S					
				1	2	3	4	5	
5.	Rainfall, sleet, and Hail	Infiltration Drainage Storm water Other water sources	Infiltration is high at Urban Park; there are drainage challenges; storm water management is a significant concern. There are no measures to tap rainfall and address drainage challenges. The Urban Park is vulnerable to storm water; does not exploit wholly other water sources; thus informing the low rating (1)	1					
Design interventions (1-Highly inadequate, 2-Inadequate 3- Fairly adequate, 4-Adequate, 5-Highly adequate)				1					

Source: Author, 2018.

Interventions applied at the Urban Park to mitigate and take advantage of precipitation are (1)/1=1; **highly inadequate**, as described in table 4.12.

Table 4.13: Design interventions in response to micro climate at Urban Park in Isiolo municipality

CLIMATIC PARAMETERS		OBSERVABLES	DESCRIPTION	RATING S					
				1	2	3	4	5	
6. Microclimate	Topography	Physical features	Mount Kenya and Nyambene hill influence the relatively high rainfall at the Urban Park. The design does not seem to capture it. However, there are indigenous plant species at the Urban Park. Design interventions made are inadequate and rated (2)		2				
	Ground cover	Type of surface	Grassland and scattered shrubs characterized the Urban Park. Design interventions made to utilize this type of surface are inadequate and rated (2)		2				
	Water	Waterbody	Water bodies provide a cooling effect; the Urban Park can tap into nearby water springs and low water tables as sources of her water features. Therefore design interventions concerning water bodies are highly inadequate and rated (1)	1					
	Building fabric and densities	Layout	The location of the Urban Park is outside the building fabric. The above observation informs the average rating in terms of interventions made in enhancing it as a significant public open space and rated (3)			3			
Design interventions (1- Highly inadequate, 2-Inadequate 3- Fairly adequate, 4-Adequate, 5-Highly adequate)					2				

Source: Author, 2018.

In response to microclimate, design interventions made at Urban Park are rated as $(2+1+3)/3=2$; **inadequate**, as described in table 4.13 above.

Table 4.14: Design interventions in response to pollution at Urban Park in Isiolo municipality

CLIMATIC PARAMETERS		OBSERVATIONS	DESCRIPTION	RATING				
				1	2	3	4	5
7. Pollution	Air	Dust, fumes	Pollution in terms of dust and fumes is mainly in Isiolo municipality's central business district. The Urban Park is located about a kilometer away; therefore, design interventions made in shaping air pollution as a constraint are promising and are rated (4)					
	Noise	Activities	The location of the Urban Park is far away from noisy activities; and therefore, design interventions made in shaping noise pollution as a constraint are promising and are rated (4)					
	Waste disposal	Dumpsite Waste bins People and waste disposal	No visible dumpsite located in the Urban Park There are no waste bins in Urban Park. People and waste disposal relationship can be said to be good as there are no pockets of waste at the urban park Therefore design interventions made in shaping waste disposal as a constraint are promising and are rated (4)					
Design interventions (1- Highly inadequate, 2-Inadequate 3- Fairly adequate, 4- Adequate, 5-Highly adequate)								

Source: Author, 2018

In response to pollution, the author rates the design interventions made at Urban Park as; $(4+4+4)/3= 4$; **adequate**, as described in table

4.14

Table 4.15: Design interventions in response to hazards at Urban Park in Isiolo municipality

CLIMATIC PARAMETERS		OBSERVABLES	DESCRIPTION	RATING					
				1	2	3	4	5	
8. Hazards	Land	<p>Landslides</p> <p>Earthquakes</p> <p>Volcanic activities</p>	There are no recorded landslides, earthquakes, or volcanic activities at the Urban Park; however, her proximity to Mount Kenya, which is a <i>stratovolcano</i> , informs the cautiously above-average rating (4) the design interventions made to safeguard her vulnerability to hazards						
	Wind	<p>Strong winds</p> <p>Sand and Dust</p> <p>Storm and Dunes</p>	The Urban Park experiences strong winds coupled with sand and dust. As a result, there are dunes of sand at Urban Park. There are no observable interventions to break the strong wind; however, the natural vegetation plays a minimal role and thus informs the rating (2) of inadequate design interventions.						
	Water	Floods	Flooding is an annual event at the Urban Park, and no visible interventions were put in place and thus rated (1). Therefore the Urban Park is highly vulnerable to flooding						
	Fire	<p>Fire station & Firefighting equipment</p> <p>Public awareness of fire and safety</p>	There is no fire station in Isiolo municipality, as of March 2018; nor firefighting engines. There is hardly any public awareness campaign regarding fire and safety. Therefore, the vulnerability to fire is high in Isiolo municipality; Urban Park has no hydrants, and all this informs the low rating of (1) on measures put in place to shape unexpected fire at the Urban Park						
Design interventions (1- Highly inadequate, 2-Inadequate 3- Fairly adequate, 4- Adequate, 5-Highly adequate)									

Source: Author, 2018.

Design interventions made at Urban Park; in response to hazards are rated as $(4+2+1+1)/4=2$, **inadequate**, as described in table 4.15

Table 4.16: Summary of design interventions in response to climates at Urban Park in Isiolo municipality

No	Climatic Design parameters	Overall Ratings				
		1	2	3	4	5
1)	Solar radiation					
2)	Temperature					
3)	Wind & air movement					
4)	Relative humidity					
5)	Precipitation					
6)	Microclimate					
7)	Pollution					
8)	Hazards					
Summary of intervention made in response to the climatic design parameters						

Source: Author, 2018

In summary; the design interventions in response to; solar radiation are rated as $(2+1)/2=1.5$; temperature are rated as $(1+1)/2=1$; wind and air movement are rated as $(1+2+3)/2=2$; relative humidity are rated as $(1)/1=1$; precipitation, are rated as $(1)/1=1$; microclimate, are rated as $(4+4+4)/3=4$; to hazards are rated as $(4+2+1+1)/4=2$. Therefore the design interventions in response to climatic parameters are rated as $(1.5+1.5+2+1+1+2+4+2)/8=1.875$; thus, **highly inadequate** and coded red as shown in table 4.16.

4.2.1.2 Appropriateness of the environmental design concept to the urban park

The environmental design concept focuses on design interventions in response to; solar radiation, temperature, wind and air movement, relative humidity, precipitation, microclimate, and hazards. These responses are discussed in 4.2.1.3 and summarized in Table 4.18.

4.2.2 Sustainable design concept

The author categorized the sustainable design principles as; UN-Habitat's sustainable design concepts, sustainable concepts from the literature review, and local traditional concepts. The author explained the sustainable design to the respondents (users, leaders, experts, and management), and their views are summarized as follows;

4.2.2.0 UN-Habitat sustainable design concept

The climate responsive design is a concept that encourages the use of available resources like shading using local tall trees. The integrated design concept introduces energy issues with a focus on efficiency—the outdoor climate mitigation concept majors on improving comfort by shading using water to cool surfaces.

The author recorded the respondents' views on appropriateness as follows; 4% highly inappropriate; 9% inappropriate; 18% reasonably appropriate; 33% appropriate, and 43% highly appropriate, as shown in figure 4.20.

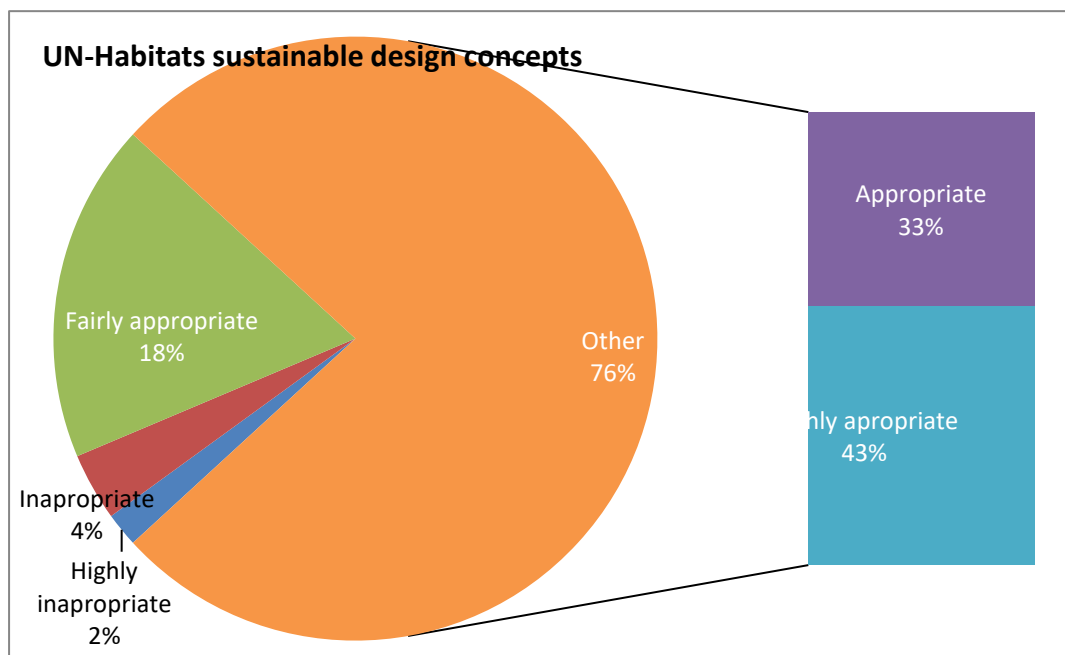


Figure 4.20: Pie chart showing Appropriateness of UN-Habitat's sustainable design concepts at Urban Park
Source: Author, 2018

4.2.2.1 Descriptive sustainable design concepts reviewed

The author explained the water conservation concept as one that encourages efficient water management systems like water recycling. The author also explained sustainable drainage as a concept that encourages on-site infiltration systems and utilization of accumulated water. The author also explained green infrastructure as a concept that encourages the restoration of natural water balance like the utilization of stormwater. The author also explained xeriscaping as a concept that encourages landscaping using appropriate plants and soil. The author also explained the shadow umbrella as a concept that encourages the shading of public open spaces and water features. Finally, the author summarized the appropriateness of the discussed concepts for people of Isiolo as follows; 4% highly inappropriate; 14% inappropriate; 20% reasonably appropriate; 27% appropriate, and 35% highly appropriate, as shown in figure 4.21

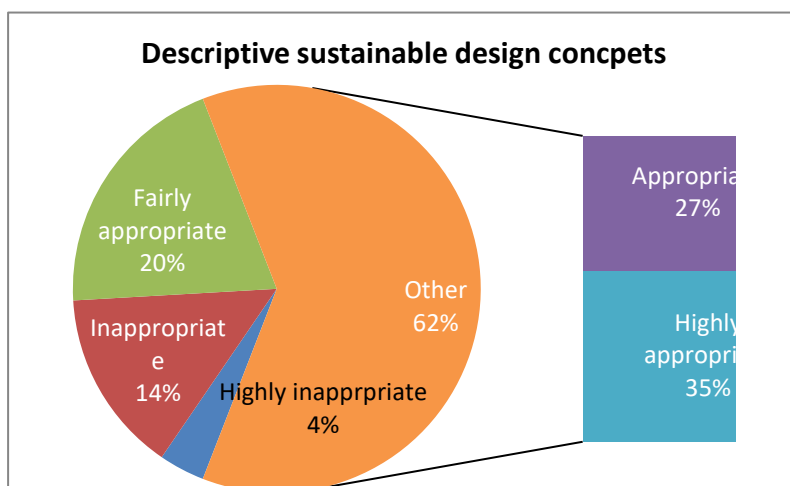


Figure 4.21: Pie Chart on Appropriateness of descriptive sustainable design concepts to the Urban Park
Source: Author, 2018

4.2.2.2 Vernacular sustainable design concepts.

Local, sustainable design concepts range from site location, choice of plant material, activities, local management mechanism, and community ownership of public open spaces. The author recorded the respondent's views on the appropriateness of local, sustainable concepts as follows; 6% highly inappropriate; 9% inappropriate; 29% reasonably appropriate; 36% appropriate, and 20% highly appropriate, as shown in figure 4.22.

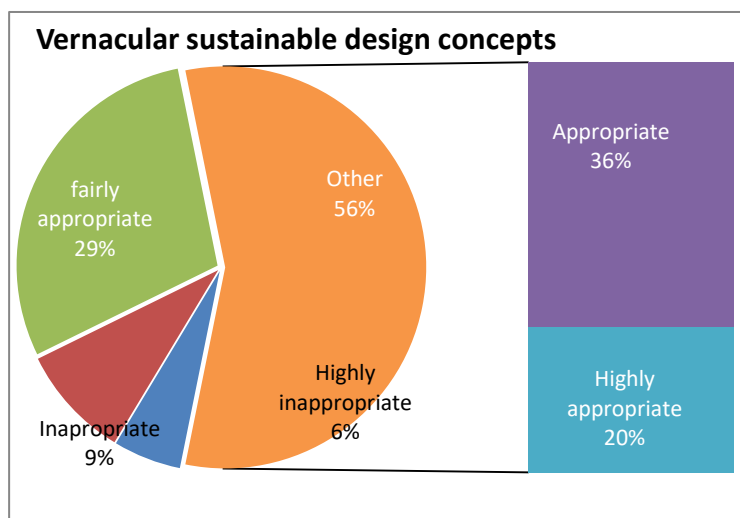


Figure 4.22 Pie chart on appropriateness of vernacular sustainable design concept to Urban Park
Source: Author, 2018

Table 4.17: Summary of the appropriateness of sustainable design concepts

N ^o	Appropriate design concepts for the Urban Park	Ratings on Average	Ratings				
			1	2	3	4	5
1.	UN-Habitat's sustainable design concepts	4.1					
2.	Descriptive sustainable design concepts	3.8					
3.	Vernacular sustainable design concepts	4.6					

Summary of the appropriateness of sustainable design concepts

Source: Author, 2018

4.2.3 Conclusions

Regarding land use, the supply of public open spaces stands at 6% against the recommended 13.2% by physical planning (2002). Furthermore, the population of Isiolo municipality will increase, putting more pressure on all public open spaces and more so on the Urban Park.

From a dimensional point of view, the study observed that; the Urban Park needs an urgent design intervention.

From a climatic response design point of view, the study observed that; the design measures taken at the Urban Park were inadequate.

To other great public open spaces, Isiolo municipality's Urban Park is light years behind.

The UN-Habitat (2014) sustainable concepts should fit at the Urban Park.

CHAPTER V - CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

The chapter highlights design problems observed at Urban Park and discusses the recommended solutions. The chapter also states the limitations of the study.

5.1 Supply, quality, and distribution of public open space as a principle

The author tabulates the above spatial index principle in table 5.1 below;

Table 5.1: Supply, quality, and distribution of public open spaces in Isiolo

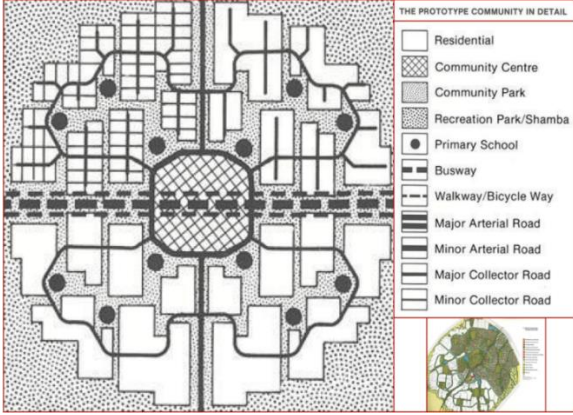
Interventions			Sketch
Supply	Quality	Distribution	
<p>The Urban Park is 160 Ha which is 5.9% of Isiolo municipality . Thus it is sufficiently supplied.</p>	<p>The maintenance budget was ten times less at 2.8 Kshs against 240 Kshs per inhabitant KUSP (2018)</p>	<p>The Urban Park is 10km away from the nearest public open space. Concerning other public open spaces, the distribution is uneven.</p>	
<p>Recommendations</p> <p>Urban designers should use public open spaces as the organizing element in hot and semi-arid climates.</p> <p>The Urban Park needs to be designed and provided with a maintenance budget.</p>			

Figure 5.1: Even distribution of public open spaces on a layout


Source: Hancock, 1976

Source: Author, 2019

5.2 Utility principle


The Urban Park should be made great by attending to place-making and place-shaping concepts as recommended in table 5.2 below:

Table 5.2.1: Activities

Interventions	Sketch
<p>The Urban Park should have; high levels of comfort; attractive, have amenities and features that sustain use during daytime and evenings.</p> <p>The Urban Park should draw in users and make them linger.</p> <p>The Urban Park should be; active, full of fun, vital, unique, and real</p>	
Recommendations	
<p>The study recommends that Urban Park design propose features like sculptures, water features, benches, and play areas; that enhance activities at the urban park</p>	<p>Figure 5.2: A sketch of a sculpture that draws in users in a public open space Source: Author, 2019</p>

Source: Author, 2019


Table 5.2.2: Associations

Interventions	Sketch
<p>The Urban Park should allow users to differentiate themselves naturally; be welcoming, neighborly, and diverse, and should enhance cooperation and stewardship</p>	
Recommendations	
<p>The study recommends that Urban Park design creatively</p>	<p>Figure 5.3: A sketch of an interactive fountain that enhances associations</p>

propose features that enhance associations like interactive water features and play areas.	Source: Author, 2019
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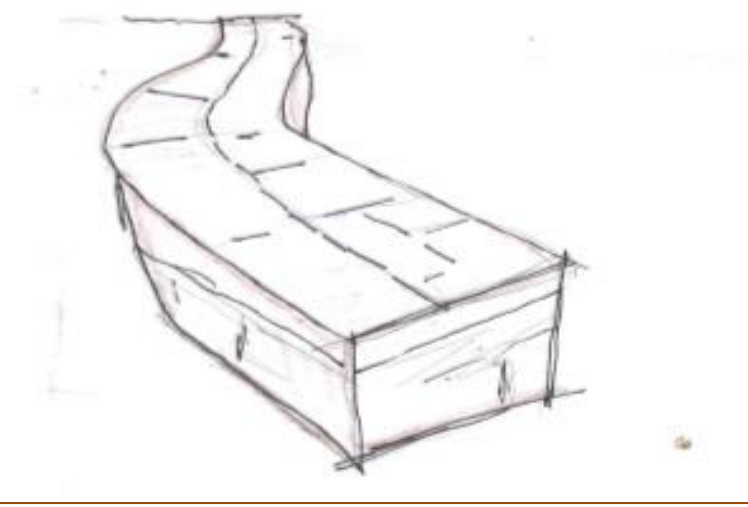
Source: Author, 2019

Table 5.2.3: Amenities

Interventions	Image
<p>The design of the Urban Park should envisage a broader view of amenities; should not exclude users based on provided amenities. The Urban Park should be safe, ‘sit-table,’ attractive, walkable, and have a positive experience.</p>	 <p>Figure 5.4: Proposed art exhibition area at Jeevanjee gardens Source: NCC, 2014</p>
<p>Recommendations</p> <p>The study recommends that Urban Park design have adequate amenities that dictate the use and attract users, like a cultural exhibition area- a platform for arts.</p>	

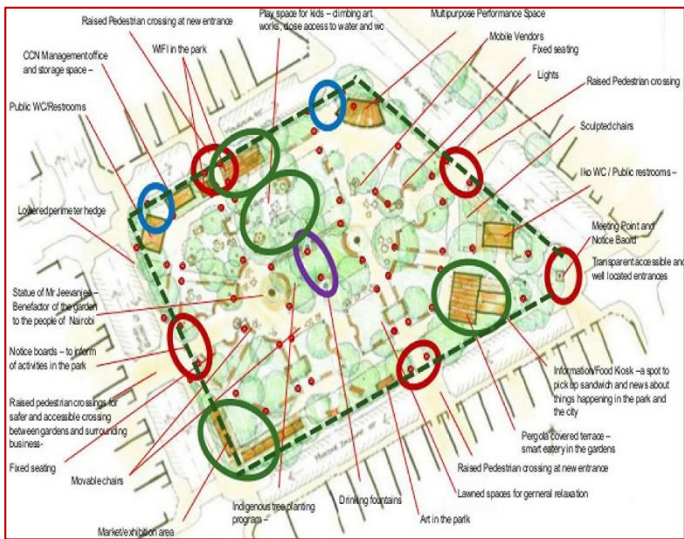
Source: Author, 2019

Table 5.2.4: Adaptation

Interventions	Sketch
<p>The Urban Park design should be adaptive to climates, acceptable, and embraced by communities.</p>	
<p>Recommendations</p>	
<p>The study recommends a resilience design for Urban Park which can be achievable by the use of adaptive plant materials, use of objects developed using locally available materials, and themes that embrace indigenous communities</p>	 <p>Figure 5. 5: A sketch of a bench made of locally available materials Source: Author, 2019</p>

Source: Author, 2019

Table 5.2.5: Appropriation

Interventions	Sketch
<p>The Urban Park should identify the likely realistic future potential of her spaces and appropriate them creatively.</p>	 <p>Labels in the sketch include: CCN Management office and storage space, Public WC/Restrooms, Lowered perimeter hedge, Statue of Mr. Jeevanji Benefactor of the garden to the people of Nairobi, Notice boards - to plan activities in the park, Raised pedestrian crossing for safer and accessible crossing between gardens and surrounding business, Fixed seating, Movable chairs, Market exhibition area, Indigenous tree planting program, Drinking fountains, Art in the park, Lained spaces for general relaxation, Raised Pedestrian crossing at new entrance, Pergola covered terrace - smart eatery in the gardens, Information/Food Kiosk - a spot to pick up sandwich and news about things happening in the park and the city, Jampanent accessible and well located entrances, Making Point and Notice Board, No WC / Public restrooms - Sculpted chairs, Lights, Raised Pedestrian crossing, Mobile Vendors, Fixed seating, Multipurpose Performance Space, Play space for kids - climbing art, works, woge access to water and wc, WFI in the park, Raised Pedestrian crossing at new entrance.</p>
<p>Recommendations</p>	

The study recommends that the Urban Park have dynamic spaces that can be converted to a different use in the future or allocate space for future use, which can be a great lawn and a forested zone.


Figure 5.6: Proposed appropriation of Jeevanjee gardens
Source: NCC 2014

Source: Author,
2019

5.3 Climate responsive design principle

The climate responsive design principle addresses the need for comfortable conditions within the Urban Park; the principle aims at reducing uncomfortable conditions. In Urban Park, solar radiation, high temperatures, and strong winds are the primary causes of discomfort. The principle advocates an Urban Park shaded, landscaped, and protected from the strong wind by windbreaks. See table 5.2 below;


Table 5.3.1: Response to solar radiation

Interventions	Sketch
<p>The Urban Park should provide comfortable conditions within it throughout the day by shaping the solar radiation constraint.</p> <p>The surface texture of the Urban Park needs to be rough and dull in color to minimize glare and reflected heat</p>	
<p>Recommendations</p>	

<p>The study recommends a landscaped Urban Park with water features like water pools or fountains, shaded areas like sitting areas, walkways and niches, and windbreaks.</p>	<p>Figure 5.7: A sketch of a Shaded sitting area Source: Author, 2019</p>
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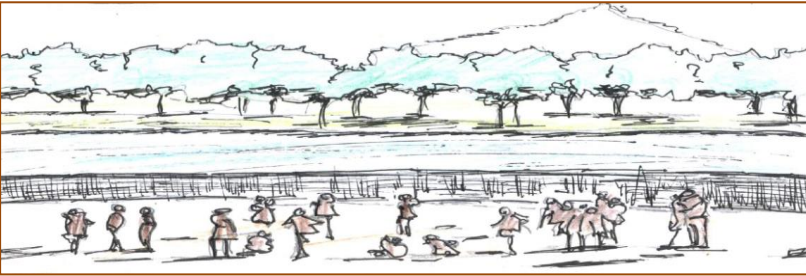
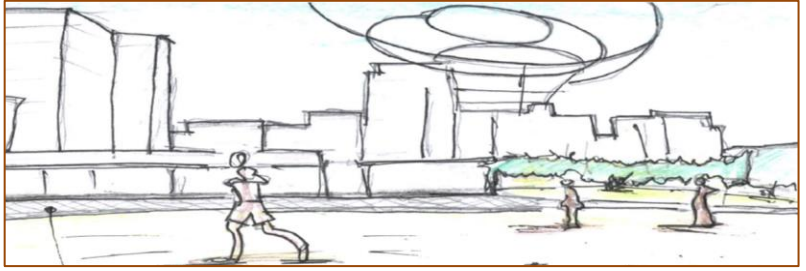
Source: Author, 2019

Table 5.3.1: Response to solar radiation – (cont.)

Recommendations	Sketch
<p>The study recommends that soft surfaces like lawns and hard shaded surfaces are dominant at Urban Park and plants specified for the Urban Park should contribute to minimizing glare, reflected heat, and energy</p>	 <p>Figure 5.8: A sketch of soft surfaces and tree-shaded areas Source: Author, 2019</p>

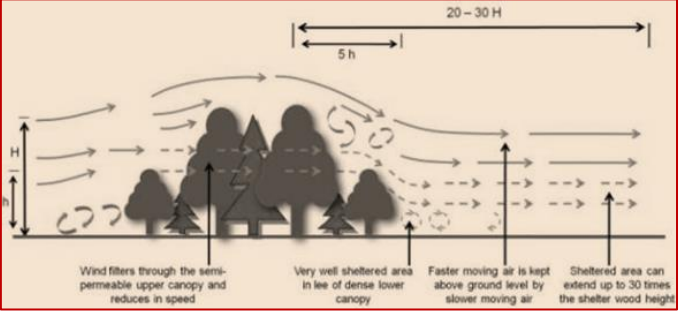
Source: Author, 2019

Table 5.3.2: Response to temperatures

Interventions	Sketches
<p>To mitigate the high temperatures, the Urban Park should enhance cooling within it throughout the day.</p>	
Recommendations	<p>Figure 5.9: A sketch of Vegetation and water features Source: Author, 2019</p>  <p>Figure 5.10: A sketch of Soft surfaces and hard surfaces Source: Author, 2019</p>
<p>The study recommends that Urban Park design propose features that enhance cooling like water surfaces; be dominated with soft surfaces like lawns, with hard shaded surfaces; and plants specified at the Urban Park should minimize glare, reflected heat, and energy.</p>	

Source: Author, 2019

Table 5.3.3: Response to wind and air movement

Interventions	Diagrams
<p>The Urban Park design should shape the strong wind experienced, which is a major constraint</p> <p>The Urban Park design should shape air movement</p>	
Recommendations	<p>Figure 5.11: Windbreak and shelterbelt design Source: University of Hertfordshire, 2011</p>
<p>The study recommends that Urban Park design should have</p>	

windbreaks and shelterbelts that protect her from strong winds using Enhance

The wind direction at Urban Park should inform the location and orientation of windbreakers

The study recommends the use of established windbreak and shelterbelt designs borrowed from best agricultural practices. See figures 5.11 and 5.12

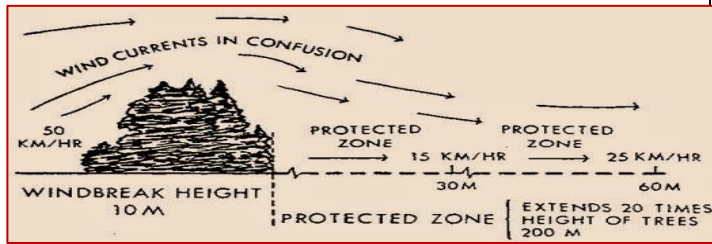



Figure 5.12: Windbreak design
Source: Balkan ecology project, 2013

Source: Author, 2019

Table 5.3.3: Response to Wind and air movement – (cont.)

Recommendations	Sketch
<p>The study recommends that Urban Park design use healthy plants, have well-ventilated surfaces, and porous materials on hard surfaces. See figure 5.13</p>	 <p>The sketch shows a landscape design with porous paving and various trees. The paving is depicted with a grid pattern, and the trees are drawn with green foliage and brown trunks. The overall scene is a cross-section of a park area with a walkway and a building in the background.</p> <p>Figure 5.13: A sketch of Porous paving and landscapes Author, 2019</p>

Source: Author, 2019

Table 5.3.4: Response to relative humidity

Interventions	Sketch
The Urban Park design should shape relative humidity: for both plants and users	See figure 5.9
Recommendations	
The study recommends that Urban Park design should have large lawns, water bodies, or water features	

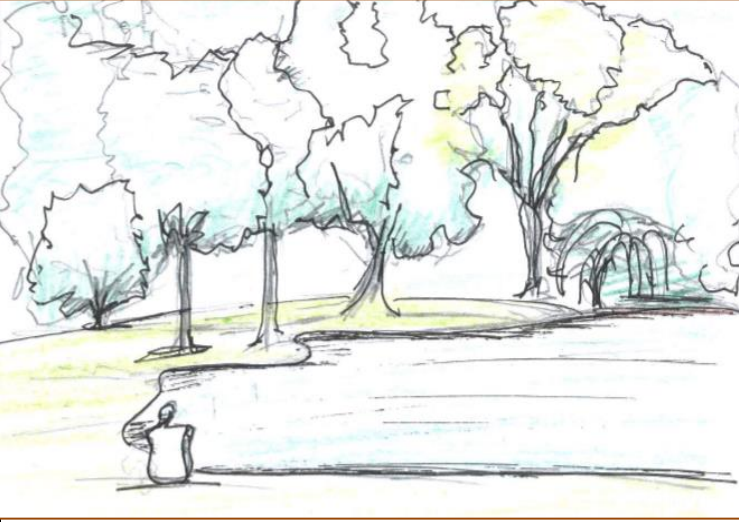
Source: Author, 2019

Table 5.3.5: Response to precipitation

Interventions	Sketch
The Urban Park should shape drainage; stormwater; flooding, and rainwater	See figure 5.13
Recommendations	
The study recommends that Urban Park design should; have an efficient and effective drainage system, a stormwater management mechanism that allows infiltration, which is essential in avoiding flooding, and utilize rainwater, which should be harvested and stored for irrigation purposes during dry seasons.	


Source: Author, 2019

Table 5.3.6: Response to the microclimate

Interventions	Sketch
<p>The Urban Park should create a microclimate and contribute to creating a comfortable environment at the Urban Park</p>	
Recommendations	
<p>The study recommends that Urban Park design should; propose features that enhance the microclimate; utilize the indigenous plant species; be adequately covered with groundcovers, and have water features for cooling purposes</p>	 <p data-bbox="655 1182 1401 1272">Figure 5.14: A sketch of a Man-made water body and great lawn</p> <p data-bbox="655 1283 1401 1339">Source: Author, 2019</p>

Source: Author, 2019

Table 5.3.7: Response to pollution

Interventions	Sketches
<p>The Urban Park is located away from dusty areas and areas with fumes.</p> <p>However, the Urban park should be free from all forms of pollution.</p>	
Recommendations	
<p>The study recommends that Urban Park designs should; have plenty of trees within them to enhance air purity</p> <p>The location of noisy activities should be far away from Urban Park.</p> <p>However, there should be room for noise barriers in an area with the potential for noise.</p> <p>Dust or fumes near Urban Park should be discouraged</p> <p>The Urban Park should be neat and have disposal bins and functional waste management.</p>	 <p>Figure 5.15: A sketch of waste bins at a public open space Source: Author, 2019</p>

Source: Author, 2019

Table 5.3.8: Response to hazards

Interventions	Diagram and Sketches
<p>The Urban Park should shape flooding and strong winds coupled with sand and dust</p> <p>There are no notable landslides, earthquakes, or volcanic activities at the urban park.</p>	<p>See figure 5.12</p>
Recommendations	
<p>In terms of location, the study recommends the engagement of urban designers at the planning level</p> <p>The study recommends that Urban Park design should; have fire safety zones; have fire hydrants in strategic areas.</p> <p>The urban park design should enhance fire and safety awareness by having fire drills; fire stations, among others</p>	

Source: Author, 2019.

5.0 Sustainable design principle

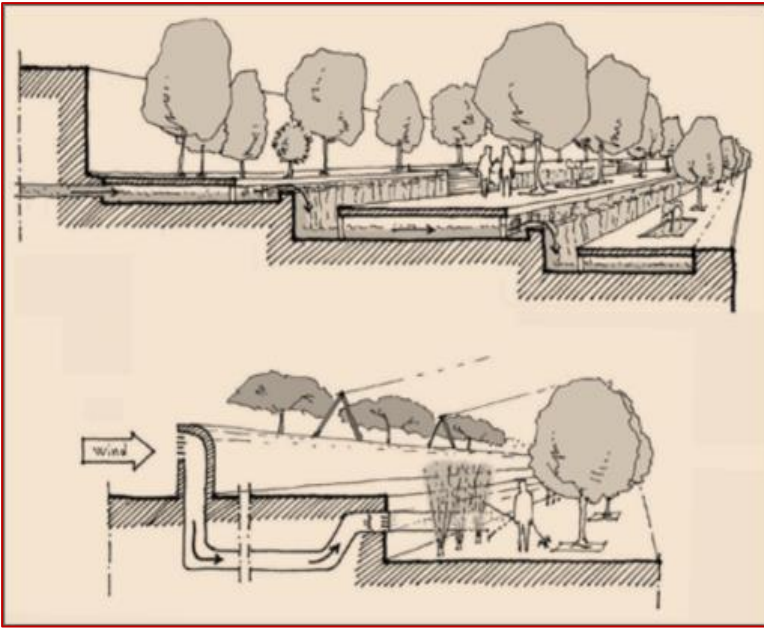
To enhance the climate responsive design principle, The Urban Park should borrow available sustainable design principles as recommended below;

Table 5.6.2: Integrated design

Interventions	Sketch
<p>The Urban Park has not utilized available energy sources. However, the respondents were open to the idea.</p>	<p>See figure 5.7:</p>
Recommendations	
<p>The study recommends that the Urban Park design taps into; solar energy and wind to minimize the amount of energy needed at the Urban Park.</p> <p>For example, by use of shades made of solar panels as seen in figure 5.7</p>	

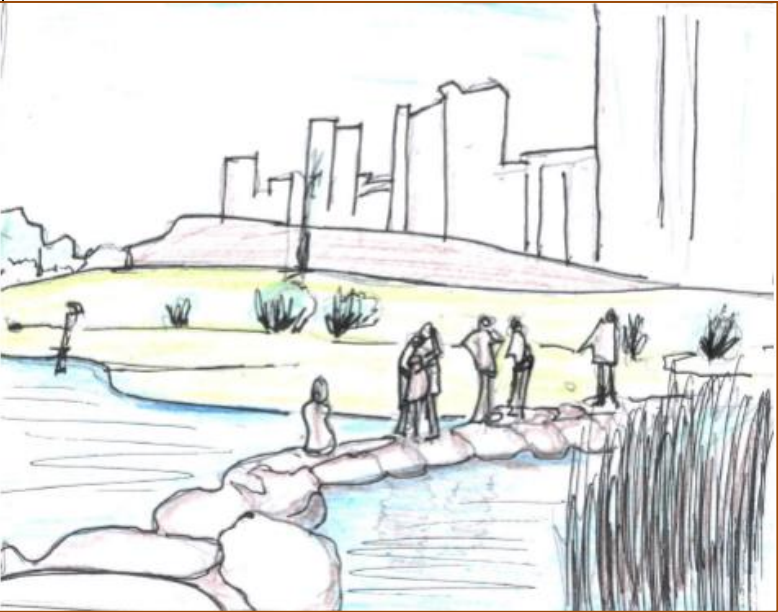
Source: Author, 2019

Table 5.6.3: Outdoor climate mitigation

Interventions	Diagram
<p>The Urban Park had not applied outdoor climate mitigation technologies in shaping climatic constraints; However, the respondents were open to the technology.</p>	
Recommendations	
<p>The study recommends that Urban Park design should embrace tested technologies like the outdoor mitigation technology advocated by the UN-Habitat to enhance its use, as seen in figure 5.16</p>	<p>Figure 5.16: Outdoor climate mitigation diagram Source: UN-Habitat 2014</p>

Source: Author, 2019

Table 5.6.4: Water conservation

Interventions	Sketch
<p>The Urban Park does not employ the water conservation concept; however, the respondents were open to the concept.</p>	
<p>Recommendations</p>	
<p>The study recommends that Urban Park design have an efficient water management system that captures; rainwater harvesting; water recycling, and water conservation technology. The water management system incorporates water cleansing plants and rocks, as seen in plate 5.17</p>	 <p>Plate 5.17: A sketch of water cleansing using plants and rocks Source: Author, 2019</p>

Source: Author, 2019

Table 5.6.5: Sustainable drainage

Interventions	Diagram
<p>The Urban Park does not employ the sustainable drainage concept; however, the respondents were open to the sustainable design concepts explained.</p>	
<p>Recommendations</p> <p>The study recommends that Urban Park design emphasize on-site infiltration systems that allow the flow of water and permit accumulation, which is cleaned and used in the Urban Park; the design should use swales and pervious surfaces to enhance water flow. See figure 5.18</p>	

Source: Author, 2019

Table 5.6.6: Green infrastructure


Interventions	Sketch
<p>The Urban park had no visible features that mimic the natural processes.</p> <p>However, the respondents were open to the familiar idea.</p>	
Recommendations	
<p>The study recommends that Urban Park design should propose features that mimic the natural processes like by having water points that retain stormwater reserved for the dry season</p>	

Figure 5.19: A sketch of a water retention pool
Source: Author, 2019

Source, Author, 2019

Table 5.6.7: Xeriscaping


Interventions	Sketch
<p>The Urban park had no visible xeriscaping features.</p> <p>However, the respondents were open to the familiar idea.</p>	
Recommendations	
<p>The study recommends that Urban Park design should; propose features that enhance tree cover, use appropriate plant material that is adaptive plants to minimize supplement irrigation, and combine indigenous plants with hardy plants.</p>	

Figure 5.20: A Sketch of hardy plants and soft rocks on a landscape
Source: Author, 2019

Source: Author, 2019

Table 5.6.8: Shadow umbrella

Interventions	Sketch
The Urban Park does not employ the shadow umbrella concept; however, the respondents were open to the concept.	See figure 5.14
Recommendations	
The study recommends that Urban Park design should propose shaded areas with water features	

Source: Author, 2019

Table 5.6.9: Vernacular strategy

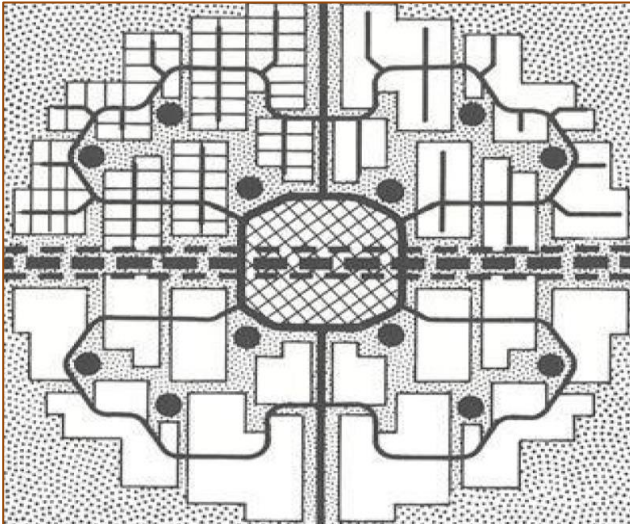
Interventions	Sketch
The Urban park had no visible xeriscaping features. However, the respondents were open to the familiar idea.	
Recommendations	
<p>The study recommends that Urban Park design should; borrow sustainable design concepts from the indigenous communities of Isiolo- like plant material, construction materials, and design layout, among others;</p> <p>extrapolate cultural activities that enhance socialization like water points, traditional games, under tree meetings, among others; provide a setting for cultural events- cultural dance, cultural ceremonies among others; incorporate the culture of the people like in Dodoma’s <i>shamba</i> system through provision for spaces for cultural activities like dances, traditional games among others</p>	


Figure 5.21: Dodoma layout that incorporates the *shamba* system

Source: Hancock, 1976

Source: Author, 2019

Table 5.6.10: A sample of plants for the Urban Park

The Urban Park should have a botanical garden, a plant nursery that is made up of indigenous plants as cataloged in Table 5.6.10

N ^o	PLANT NAMES	LOCAL NAMES			LOCAL USE	Sketch
		BORAN	SAMBURU	SOMALI		
1.	<i>Acacia nilotica</i>	<i>Burquge/Burquqe/Burquqis</i>	<i>Ilkilositi</i>		Poles, tools, carving, meat tenderizer, the fruit pulp is drunk like tea, shade, Windbreak, soil stabilization, and fence	 <p>Figure 5.22: A sketch of the umbrella-shaped acacia Source: Author, 2019</p>

Source: Author, 2019.

5.5 Limitations and further areas of study

The study is limited to the urban park as a public open space in the hot semi-arid climate, which excludes other public spaces.

Further areas of the study area; streets of Isiolo municipality as public spaces in hot semi-arid climates

5.6 Conclusions

The study recommends the use of public open spaces as the main organizing element in hot and semi-arid climates. The study recommends introducing activities like cultural play areas and children's play areas to enhance the use and use of water features to draw in users. The study suggests using windbreakers on the southern side, water features, lawns, and shades to enhance comfort. The study also recommends using local and new technologies to improve sustainability; like water harvesting; using water ponds, and solar energy to light the urban park. The study proposes the spatial index principle, the utility principle, the climate-responsive principle, and the sustainable design principle as the guiding principles for public spaces in hot semi-arid climates.

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